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Ascidiacea (Tunicata) from Darwin, Northern Territory, Australia

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ABSTRACT

Forty species of ascidians from the Northern Territory (mostly from Darwin Harbour) are discussed. These include three new species (*Clavelina amplexa* sp. nov., *Distaplia cuspidis* sp. nov. and *Leptoclinides complexus* sp. nov.). All the species discussed below are colonial and over one half are in the family Didemnidae, suggesting that the prolific replication resulting in exponential rates of colony growth, flexibility in form and viviparous habit displayed by these organisms may be a selective advantage in the tropics. These also may be factors contributing to the tropical diversity reflected in this collection from the northern coast of Australia which, separated from Indonesia and the islands to the north only by the Timor Sea, is in the centre of the Indo-west Pacific tropical region.

KEYWORDS: Ascidiacea, Tunicata, Didemnidae, Darwin Harbour, northern Australia, new species, tropical diversity, ovoviviparous, colonial, replication, Indo-west Pacific.

INTRODUCTION

The class Ascidiacea, sessile organisms of the subphylum Tunicata (Protochordata), are a conspicuous part of the filter-feeding component of benthic marine invertebrate communities. Ascidians strain micro-organisms and organic particles from vast quantities of water driven through their large pharynges by the cilia lining the pharyngeal perforations. Although both solitary and colonial species are fixed to the substrate throughout their adult lives, their tailed, free swimming larvae ensure recruitment, gene flow and site selection.

Although comprehensive treatments of the Ascidiacea are presented by Kott (1985; 1990a,b; 1992a,b; 2001), examination of additional material is revealing further diversity in this class of the Tunicata which abounds around the Australian continent and in the tropical Indo-west Pacific. Some recent accounts of tropical western Pacific species, have been revised in the light of this additional material, some misconceptions have been corrected and some synonymy is resolved. The fact that northern Australia is part of the Indo-west Pacific tropical area is emphasised by these records and the biodiversity of its marine fauna is reflected in the growing catalogue of species recorded.

All of the 40 species discussed here are colonial (over half are in the family Didemnidae), with similar colony organisation and small zooids associated with prolific replication, rapid exponential growth rates, flexibility in growth form and a viviparous habit. These strategies appear to be selective advantages in tropical waters and contribute to tropical species diversity (see Kott 2001).

Darwin Harbour, one of the most northerly locations of the Australian continent and well north of the Tropic of Capricorn, is separated from Timor and the Sunda Islands of Indonesia only by the Timor Sea and its longitude is in the centre of the Indo-west Pacific tropical region. It might be expected to act as a refuge for species of both the north-eastern and north-western Australian coasts as well as Indonesian species and may play a significant role in gene flow and recruitment of tropical species into Australian waters. Up to the present time, however, it has not been a well-collected location for the Ascidiacea. Previously only 21 species were recorded from Darwin and 28 from other parts of the Northern Territory (including eight recorded also from Darwin). Species diversity in Darwin Harbour could also be expected to be enhanced by the maritime activity in these ports, including the provision of a diversity of substrates and habitats represented by harbour installations such as vertical wharf piles.

The following account is based mainly on collections made (by SCUBA) at five locations (off East Point, Iron Ore Jetty, Mandorah Jetty, Plater Rock, reef off Charles Point) in Darwin Harbour (Fig. 1) by Karen Gowlett Holmes, and of the 40 species discussed, 38 are from this collection. The other two species are from Port Essington and the Gulf of Carpentaria. Two new species are described from the Darwin Harbour collection, and one is from Port Essington. The majority

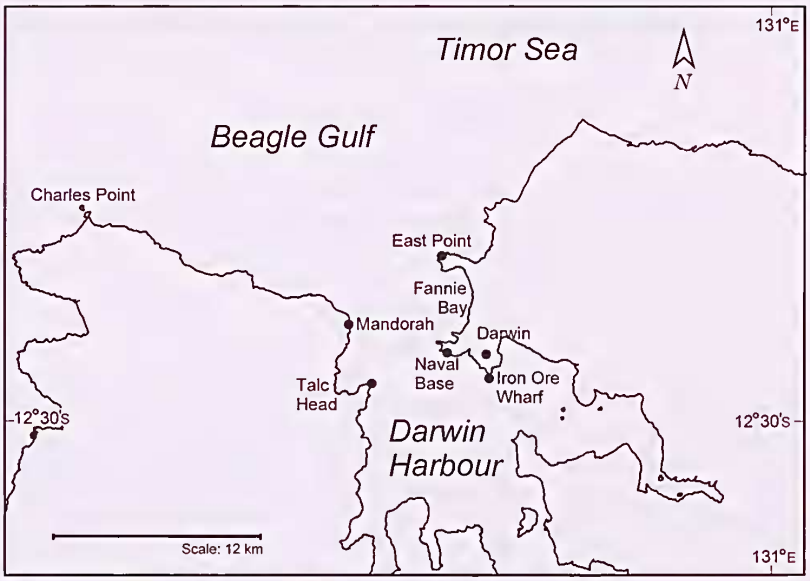

Fig. 1. Darwin Harbour, showing collecting locations.

of the species are newly recorded from Darwin, only nine having been recorded previously, viz. *Clavelina oliva* Kott, 1990a, *Pycnoclavella diminuta* (Kott, 1957), *Hypodistoma deerratum* (Sluiter,1895), *Sycozoa seiziwadai* Tokioka, 1952, *Tridemnum savignii* (Herdman,1886), *Didemnum clavum* Kott, 2001, *D. molle* (Herdman, 1886), *Diplosoma virens* (Hartmeyer, 1909) and *Aplidium multiplicatum* Sluiter, 1909, and are also known from other tropical Australian locations. Six species – *Distaplia mikropnoa* Sluiter, 1909, *Polysyncraton pavimentum* Monniot, 1993, *Tridemnum marmoratum* (Sluiter, 1909), *T. planum* Sluiter, 1909, *Didemnum madeleinae* Monniot and Monniot, 2001 and *D. parau* Monniot and Monniot, 1987 – are newly recorded from Australia. The species list for Darwin has been increased from 21 to 49 and that for the Northern Territory generally (including Darwin) from 41 to 70. Forty of the species now known to occur in Darwin have a range that includes Indonesia and/or other parts of the western Pacific. Despite the fact that the majority of species known from the Northern Territory are those recorded from Darwin, this new sampling has taken only 12 of the 41 species formerly recorded from the Northern Territory, and only few of the newly recorded species were taken more than once. These figures demonstrate how poorly the Northern Territory and Darwin ascidian fauna is known.

Species recorded from Darwin

*Species recorded only in previously published works (see Kott 1985, 1990a, 1992a, 2001).

**Species newly recorded from Darwin but not discussed in this work.

Note: formal page citations for new species are indicated below, although they may be referred to informally in prior pages.

Clavelinidae Forbes, 1848
- *Clavelina amplexa* sp. nov. (p. 21)
- *Clavelina oliva* Kott, 1990a
- *Nephtheis fascicularis* (Drasche, 1882)*

Pycnoclavellidae Kott, 1990a
- *Pycnoclavella diminuta* (Kott, 1957)

Holozoidae Berrill, 1950
- *Distaplia cuspidis* sp. nov. (p. 23)
- *Distaplia mikropnoa* (Sluiter, 1909)
- *Distaplia regina* Kott, 1990a
- *Sycozoa seiziwadai* Tokioka, 1952
- *Hypodistoma deerratum* (Sluiter, 1895)

Polycitoridae Michaelsen, 1904
- *Polycitor circes* Michaelsen, 1930
- *Eudistoma eboreum* Kott, 1990a
- *Eudistoma superlatum* Kott, 1990a
- *Cystodytes philippinensis* (Herdman, 1886)

Polyclinidae Milne Edwards, 1841
- *Synoicum macroglossum* Hartmeyer, 1919
- *Aplidium grisiatum* Kott, 1998
- *Aplidium altarium* (Sluiter, 1909)*
- *Aplidium multiplicatum* Sluiter, 1909

Didemnidae Giard, 1872
- *Leptoclinides aciculus* Kott, 2001
- *Polysyncraton arafurensis* Tokioka, 1952
- *Polysyncraton cuculliferum* (Sluiter, 1909)
- *Polysyncraton dromide* Kott, 2001

Polysyncraton pavimentum Monniot, 1993
Polysyncraton pseudorugosum Monniot, 1993
Polysyncraton purou Monniot and Monniot, 1987
Didemnum clavum Kott, 2001
Didemnum granulatum Tokioka, 1954
Didemnum madeleinae Monniot and Monniot, 2001
Didemnum membranaceum Sluiter, 1909
Didemnum molle (Herdman, 1886)
Didemnum parau Monniot and Monniot, 1987
Didemnum perplexum Kott, 2001
Didemnum psammatode (Sluiter, 1895)
Trididemnum cyclops Michaelsen, 1921*
Trididemnum planum Sluiter, 1909
Trididemnum savignii (Herdman, 1886)
Trididemnum sibogae (Hartmeyer, 1910)
Lissoclinum badium Monniot and Monniot, 1996
Lissoclinum bistratum (Sluiter, 1905a)*
Lissoclinum conchylium Kott, 2001
Lissoclinum durabile Kott, 2001
Lissoclinum badium Monniot and Monniot, 1996
Lissoclinum limosum Kott, 2001
Lissoclinum multifidum (Sluiter, 1909)
Diplosoma translucidum (Hartmeyer, 1909)
Diplosoma virens (Hartmeyer, 1909)

Ascidiidae Adams and Adams, 1858
Ascidia capillata Sluiter, 1887*
Ascidia sydneiensis Stimpson, 1855*
Phallusia millari Kott, 1985**

Perophoridae Giard, 1872
Ecteinascidia diaphanis Sluiter, 1885*

Styelidae Sluiter, 1895
Cnemidocarpa areolata (Heller, 1878)*
Polycarpa papillata (Sluiter, 1885)*

Pyuridae Hartmeyer, 1908
Microcosmus exasperatus Heller, 1878*

In addition to species newly recorded from Darwin, *Leptoclinides complexus* sp. nov. (p. 30) from Port Essington and *Trididemnum marmoratum* (Sluiter, 1909) from the Gulf of Carpentaria are discussed below.

METHODS

Material referred to by a museum registration number has been examined in connection with this work. A museum registration number of part of a colony is in italics immediately following the number of the colony sampled. Museums are referred to by the following abbreviations: AM, Australian Museum, Sydney; AIMS, Australian Institute of Marine Sciences, Townsville; NTM, Museum and Art Gallery of the Northern Territory, Darwin; QM, Queensland Museum, Brisbane; ZMA, Zoological Museum University of Amsterdam, The Netherlands; ZMH, Zoological Museum, University of Hamburg, Germany.

Methods used to examine material, conventions used in describing it and discussions on definitions and relationships of genera, families and higher level taxa are set out in the relevant volume of the Australian Ascidiacea (Kott 1985, 1990a, 1992a, 2001).

In this and all previous works by the present author, the number of stigmata per row is the number between the dorsal and ventral midlines on one side of the pharynx only.

The month that larvae were found in the colonies is recorded to contribute data on breeding seasons.

TAXONOMY

Family Clavelinidae

***Clavelina amplexa* sp. nov.**

(Figs 2A–C, 21A,B)

? Clavelina robusta - Kott, 1990a: 242, pl. 4g.

Not *Clavelina robusta* Kott, 1990a: 61.

Records. *Type locality:* Northern Territory, Darwin, off East Point, 6–8 m, coll. K. Gowlett Holmes, 19 September 1999, holotype NTM E155; reef off Charles Point, 6–8 m, coll. K. Gowlett Holmes, 16 July 2001, paratype NTM E208. *Further records:* Mandorah Jetty, NTM E218. *Previously recorded* (see Kott 1990a): ? Western Australia (Port Hedland).

Description. The newly recorded specimens are translucent with a broad opaque creamish-yellow triangular patch each side of the antero-dorsal midline, the apex of each triangle projecting in between the apertures, and the base drawn out around the atrial siphon, sometimes continuous behind it but often interrupted across the dorsum behind the aperture (Figs 21A,B). The pigment is not in the actual rim of the apertures. Lines or broader flashes of the same colour often extend down the dorsal and ventral midlines. Zooids are up to 2 cm long and branch off a common basal stalk. They are blue in preservative. Muscles are arranged according to the formula 7E, 5B, 3D (see Kott 1990a). The branchial sac is broad with about 20 rows of 20 to 30 stigmata. The anal border has a fringe of short papillae around the rim. Embryos are crowded in a brood pouch on the right side of the top of the oesophageal neck where development begins. It proceeds as embryos move up into the thorax and across the posterior end of the right side of the thorax to its ventral margin where they are liberated from the oviduct into the atrial cavity.

Larvae (present in the holotype and the paratype) have a 1 mm long trunk and a relatively short tail barely reaching to the anterior end of the trunk. Five rows of

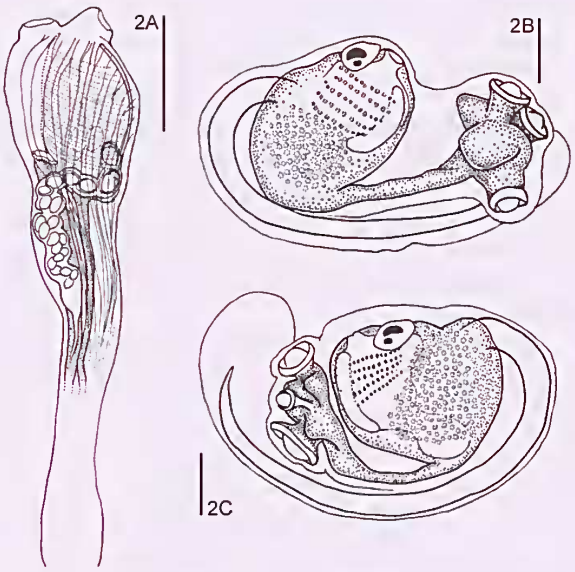

Fig. 2. *Clavelina amplexa* sp. nov.: **A**, zooid (NTM E155 holotype); **B**, larva (NTM E155 holotype); **C**, larva (NTM E208 paratype). Scale bars: **A**, 5.0 mm; **B**, **C**, 0.2 mm.

up to 17 short stigmata are in the oozooid. The tail fin is particularly broad terminally. The triradially arranged adhesive organs are on a flattened frontal plate connected to the postero-ventral part of the trunk by a long, narrow stalk and a broad ampulla projects from the plate at the base of each adhesive organ.

Remarks. *Clavelina robusta* Monniot and Monniot, 1996 and 2001, and *Clavelina* sp. *sensu* Monniot and Monniot, 1996 have a complete band of colour around the margin of each zooid opening as described for Philippine specimens of *C. robusta* (QM G12757: Kott 1990a). The colour pattern in the present species, which lacks the continuous band of pigment found in the rim of the apertures in *C. robusta*, resembles the photographed specimens from Port Hedland questionably assigned to *C. robusta* by Kott (1990a). As well as the colour pattern, significant differences that can be detected between the present species and *C. robusta* are the less robust zooids with fewer stigmata (about 20 per row, but up to 60 in *C. robusta*) and a slightly shorter larval trunk and longer stalk connecting the frontal plate to the oozooid. The colour pattern in this species resembles that in some colonies of *Clavelina arafurensis* (see Kott 1990a, pl. 1f), although the latter species is clearly distinguished by its embedded zooids.

The large expanded terminal tail fin appears to be present in most these large clavelinid larvae although it has not been described previously (see Kott 1990a).

The species name is from the Latin *amplexus,* and refers to the colour band encircling the apertures.

Clavelina oliva Kott, 1990

(Fig. 21C)

Clavelina oliva Kott, 1990a: 55.

Records. *New records*: Northern Territory (Darwin, Plater Rock, NTM E176). *Previously recorded* (see Kott 1990a): Western Australia (Shark Bay, Dampier Archipelago, Houtman Abrolhos), Queensland (Lindeman Island), Northern Territory (Darwin), Philippines.

Description. The *in situ* photograph (Fig. 21C) of the newly recorded specimens shows the small zooids projecting up through the sediments with a thick white band crossing the dorsum between the two apertures and with a median vertical white mark over the anterior end of the endostyle tapering posteriorly. The zooids are otherwise translucent. The colour appears to be variable, Kott (1990a) reporting white, yellow or green bands around the siphons, sometimes extending down the dorsum and with freckles of the same colour on other parts of the thorax.

The newly recorded specimens are relatively small (to 2 cm long) contracted zooids, a few joined basally. Thoracic muscles are arranged according to the formula for this species, viz. 8E, 3B, 3D (see Kott 1990a).

Remarks. Zooids resemble *Clavelina fecunda*, although the latter species has shorter zooids and the abdomina embedded in the basal test; and *Clavelina robusta* (with longer zooids in branching stalks, and shorter vascular stolons).

Family Pycnoclavellidae

Pycnoclavella diminuta (Kott, 1957)

(Fig. 21D)

Clavelina diminuta Kott, 1957: 89.

Pycnoclavella diminuta - Kott 1990a: 73 and synonymy.

Archidistoma diminutum - Monniot 1997: 195.

?Archidistoma dublum Monniot, 1997: 196.

Records. *New records*: Northern Territory (Darwin, Plater Rock, NTM E177). *Previously recorded* (see Kott 1990a): Western Australia (Exmouth Gulf to Rottnest Island), Great Australian Bight, Lord Howe Island; Queensland (Heron Island to Lizard Island), Northern Territory (Darwin), Philippines.

Description. The species is characterised by its three rows of up to 100 stigmata, the anterior and posterior rows (respectively) deflected anteriorly and posteriorly along the mid-line, brown vesicles in the test of the stalks, a cluster of testis follicles in the loop of the gut, larvae with two tubular adhesive organs and an otolith as well as an ocellus, and a developmental sequence of a variable number of embryos in the oviduct. Embryos begin their development at the base of the abdomen.

Remarks. *Archidistoma dublum* Monniot, 1997 from Mozambique, sympatric with specimens assigned to *P. diminuta*, and differing from it only in being twice the size, may be a junior synonym of this highly variable species.

The tubular larval adhesive organs, fertilisation at the base of the oviduct, long oesophageal neck, smooth apertures, and small testis are all characteristics of *Pycnoclavella* (see Kott 1990a; in press).

Family Holozoidae

Distaplia cuspidis sp. nov.

(Figs 3A, B, 21E, F)

Distaplia regina - Monniot and Monniot 1996: 216.

Not *Distaplia regina* - Kott 1990a: 125. - Monniot and Monniot 2001: 257.

Records. *Type locality:* Northern Territory, Darwin, Plater Rock, 8–10 m, coll. K. Gowlett Holmes 21 September 1999, holotype NTM E171; 6–8 m, coll. K. Gowlett Holmes, 15 July 2001, paratype NTM E198). *Previously recorded* (see Monniot and Monniot 1996): Palau Islands.

Description. The colonies are translucent in preservative, but yellow-cream colour in life. Zooids are arranged in crowded circular to elongate systems in an irregular sponge-like encrusting colony. The surface of the colony often is depressed over each system. Many common cloacal openings are conspicuous, protuberant, circular openings with lobes accommodating the atrial lips, which appear to be white and clearly show through the test. However, sometimes the common cloacal apertures are long, open troughs overlapped along each side by a straight rim of test, and with atrial openings in a groove beneath this rim. Also, in some photographs there appear to be one or more pointed projections from the branchial and common cloacal apertures on the surface of the colony which, with the protuberant apertures, make it look spiky.

Zooids have large, almost spherical thoraces with fine longitudinal thoracic muscles and four rows of about 25 stigmata. The long stigmata lie regularly parallel to one and although parastigmatic vessels were not detected, fine vessels may once have been present holding the stigmata in place. The atrial aperture has a large pointed anterior lip and a smaller pointed posterior lip. Only about six short branchial tentacles alternate with rudimentary ones. The gut loop is vertical, and a cluster of male follicles is enclosed in the loop. The stomach wall has what appear to be crowded circular concavities in the inner lining. The rectum makes a right-angle bend to cross the oesophagus.

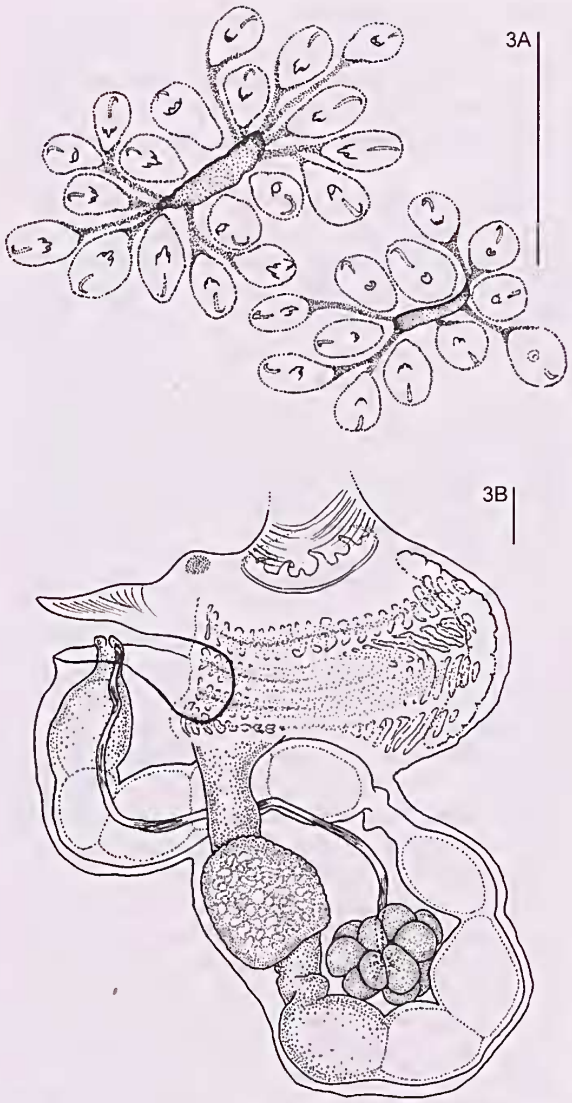

Fig. 3. *Distaplia cuspidis* sp. nov. (NTM E171, holotype): **A**, colony; **B**, zooid. Scale bars: **A**, 5.0mm; **B**, 0.2 mm.

Remarks. *Distaplia regina* Kott, 1990a, *D. racemosa* Kott, 1990a and the present new species have gonads in the gut loop, circular systems, an even external stomach wall without longitudinal folds or ridges and similar zooids with about the same number of stigmata. *Distaplia racemosa* systems are smaller, regularly circular, evenly spaced and well separated from one another, its thoracic muscles are predominanty transverse (crossing the endostyle) and the stomach lining does not have the distinct circular areolations of either *D. regina* or the present species. *Distaplia regina* is distinguished by its deep blue colour in life, dark red pigment cells in the test that persist in the preserved specimens, fewer stigmata, short irregular ridges that

form a reticular pattern in the stomach lining (rather than crowded circular concavities), a narrow gut loop with gonads protruding from the side of the zooid, fewer testis follicles and a smooth surface without protruding common cloacal apertures or branchial lobes.

Distaplia regina sensu Monniot and Monniot (1996) from the Palau Islands is identical with the present specimen. *Distaplia regina sensu* Monniot and Monniot (2001), also from the Palau Islands, has a right angle bend in the rectum, a circular pattern in the stomach wall and numerous male follicles in a grape-like cluster in the gut loop like the present species. However, it is said to have club-shaped or cushion-like colonies with the zooids in lines converging at the top of the colony like the cloacal systems in *D. mikropnoa*. Thus *D. regina* – Monniot and Monniot (2001) does not appear to be conspecific with either *D. mikropnoa* or the present species and is distinguished from *D. regina* Kott (1990a) by its cluster of numerous testis follicles and a different colony.

Distaplia cuspidis is most consistent in its zooids and colony as evidenced by photographs of specimens from Darwin and the Palau Islands (Monniot and Monniot 1996: pl. 7a). It is distinguished by its soft spongy test, projecting cloacal apertures and branchial lobes, pink/beige colour, circular pattern of apparent concavities in the stomach wall, wide loop of the post-pyloric part of the gut loop and right angle bend of the rectum to completely enclose the gonads.

The species name is from the Latin "cuspis", the point or the head of a spear. It refers to the points on the surface of the colony surrounding the apertures.

Distaplia mikropnoa (Sluiter, 1909)

(Figs 4A–C, 21G,H)

Polyclinum mikropnous Sluiter, 1909: 94

Distaplia mikropnoa - Tokioka 1955: 51. - Tokioka 1967: 129. - Monniot and Monniot 2001: 256.

Records. *New records*: Northern Territory (Darwin, Plater Rock, NTM E199, E200). *Previously recorded* (see Tokioka 1955, 1967; Monniot and Monniot 2001; Sluiter 1909): Palau Islands, Indonesia.

Description. The newly recorded specimen is a large (maximum width 35 mm, 40 mm high) flattened cone (the head of colony) with the fleshy stalk removed from its asymmetrical point of attachment at one side of the base of the colony. Zooids are in about 30 double rows, converging from the wide base to the top of the head. The head is a translucent creamish colour and a pink colour resulting from faecal pellets in the rectum. The pink spot associated with the neural ganglion (Monniot and Monniot 2001) was not detected. About 20–25 stigmata per row are in the branchial sac. Parastigmatic vessels were not detected, nevertheless, the long parallel stigmata are in place despite distortion

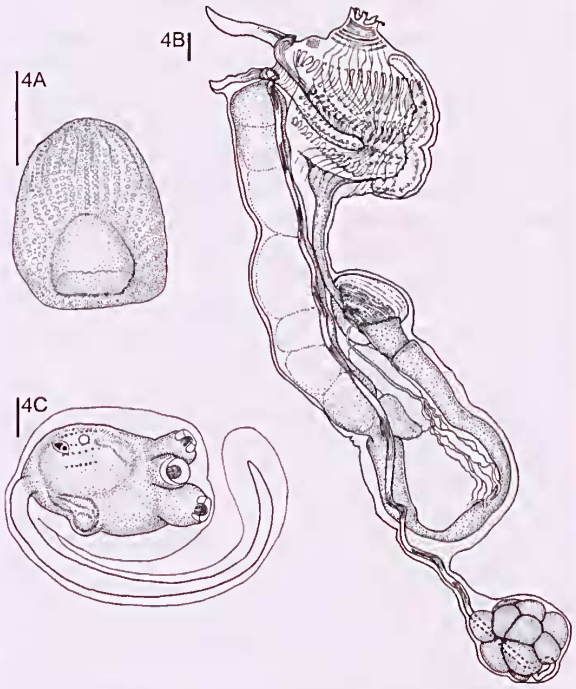

Fig. 4. *Distaplia mikropnoa* (NTM E199): **A**, colony; **B**, zooid; **C**, larva. Scale bars: **A**, 2.0 cm; **B**,**C**, 0.2 mm.

of the thoraces. Several of the most dorsal of up to 20 longitudinal thoracic muscles divert out around the large anterior atrial lip and the posterior rim of the atrial opening also projects out in a lip. The stomach has about 20 fine, parallel longitudinal ridges that appear to protect slightly from both the internal and external surface. The oesophagus is longer than has been reported previously, the stomach being nearly half way down the descending limb of the long vertical gut loop. The duodenal region is short, opening into a slightly wider mid-intestine through a distinct valve. There is no posterior stomach, the even, tubular mid-intestine continuing around the pole of the loop and abruptly entering the rectum a short distance up the ascending limb of the loop. No distinct reservoir of the gastro-intestinal gland was detected in this specimen. Relics of the epicardial sacs (see Tokioka 1967: fig. 46e) are evident in some (but not all) zooids, a system of branched ducts are present in the gut loop along the descending (proximal) part of the mid-intestine and a flap of tissue attached to the ascending (distal) part of the mid-intestine curves around its inner wall. Clumped testis follicles and an ovary are in the gonad sac attached to the zooid by a long narrow ligament containing the gonoducts. The flap-like organ – which Tokioka (1967) thought might be a circumintestinal gland – always is present in the vicinity of the mid-

intestinal junction with the rectum and appears to be the heart. It is not associated with the duct of the gastro-intestinal gland which extends vertically from the stomach down along the inside of the post-pyloric part of the descending limb of the gut loop, where it branches into many tubules.

A single embryo is incubated in a brood pouch projecting from the postero-dorsal corner of the thorax. The larval trunk is 1.0 mm long and the stalk is wound two-thirds of the way around it. The three triradially arranged adhesive organs have deep epidermal cups and thick bulbous stalks. The oozooid, near the posterior end of the trunk, has four rows of stigmata and the gut loop is tucked up horizontally behind the thorax. Larvae are present in July.

Remarks. The zooids, larvae and colony are like those formerly reported for this species, which previously has not been taken in Australian waters.

The disposition of the main duct of the gastro-intestinal gland which, in this species, does not cross from the stomach to the ascending limb of the gut loop but extends down the descending loop is unusual and may be associated with the longer than usual post-pyloric part of the narrow vertical gut loop.

The 'pyloric ampulla' referred to by Monniot and Monniot (2001) has no homologue in the Ascidiacea unless it is the misplaced gastric reservoir (of the gastro-intestinal gland) found in other species of the Holozoidae. However such a reservoir has not been detected in the newly recorded specimens. The organ figured by Monniot and Monniot (2001: fig. 44A) is in the position of the heart but the nature and homology of ligaments or ducts-shown in the figure are not known and they have not been detected in the present specimens.

The lack of a posterior stomach and the long mid-intestine curving around in the pole of the gut loop are characters shared with other species of the Holozoidae and may be family characters additional to those discussed by Kott (1990a).

Kott (1990a) was mistaken in referring to an anastomosing network of stomach folds and a stalk as the characters distinguishing this species from *Distaplia stylifera*. The zooids of *D. stylifera* (including the longitudinally ridged stomach) are similar to those of the present species and both species have a similar fleshy stalk. The long double rows of zooids converging to terminal common cloacal apertures, long post-pyloric part of the gut loop, lack of a gastric reservoir and the course of the gastro-intestinal ducts distinguish the present species from *D. stylifera* (which has oval to elongate systems, common cloacal apertures all over the head, a short abdomen, a gastric vesicle and the gastro-intestinal gland extending from the stomach to the ascending limb of the gut loop).

Sycozoa seiziwadai Tokioka, 1952

(Figs 22A–H)

Sycozoa seiziwadai Tokioka, 1952: 99.

Sycozoa seiziwadae - Kott 1990a: 152 and synonymy.

Sycozoa cerebriformis - Monniot and Monniot 2001: 259.

Records. *New records*: Northern Territory (Darwin, Plater Rock, NTM E161–2 E164 E219). *Previously recorded* (see Kott 1990a, Monniot and Monniot 2001): NW Australia (Cape Jaubert, Broome, Port Hedland, Dampier Archipelago, Cape Preston), NE Australia (Cronulla, Great Barrier Reef), Arafura Sea, New Caledonia, Philippines, Indonesia.

Remarks. Monniot and Monniot (2001) have compared the juvenile holotype colony of *Sycozoa cerebriformis* (Quoy and Gaimard, 1834) with newly recorded colonies of the present species from Indonesia. Without reference to the descriptions and discussions of Hartmeyer (1919), Michaelsen (1923, 1924), Tokioka (1952), Millar (1963, 1975) and Kott (1990a), all drawing attention to differences in the colony form of various *Sycozoa* spp., Monniot and Monniot (2001) argue that the present species is conspecific with *S. cerebriformis*. Although both species are fleshy with stalks that sometimes branch and heads that sometimes fuse, there are significant differences in colonies, zooids and larvae (see also Tokioka 1952, Kott 1990a).

Sycozoa seiziwadai is a tropical species with conical to fan-shaped heads, ovoid in transverse horizontal section, each on a terminal branch of the thick fleshy arborescent main stalk, with up to 16 double rows, each of 10–15 functional zooids, per head. As the colony grows, the number of branches, each with its terminal head, increases and adjacent heads usually fuse around their upper margins. However the heads remain inverted cones to fans and although their number increases neither their size nor their shape changes in any significant way. *Sycozoa cerebriformis* is a temperate species in which juvenile colonies have a fan-shaped head. With growth the head becomes a wide, flat, relatively narrow ribbon, sinuously folded and convoluted, its lower edge gathered into the top of a short, fleshy stalk, which only occasionally branches. Rarely the ribbon-like convoluted head may fuse with an adjacent head. With growth the heads increase in width and convolutions to form tight rosettes of ever increasing size and complexity. Kott (1990a) refers to one head that (if unfolded) would measure 74 cm, forming a convoluted rosette 8 cm in diameter. Only about eight functional zooids per row occupy the top 1 cm of each head, but the number of double row systems in one of these folded heads vastly exceeds the number in the relatively narrow conical to flat or only slightly curved heads of *S. seiziwadai*.

The zooids of *S. seiziwadai* have 18–20 stigmata per row (up to 15 in the last two rows in *S. cerebriformis*). Larvae of *S. seiziwadai* have a trunk 0.7 mm long with the tail wound almost completely around it (although the tail fin is longer) and what appears to be three small buds (Millar 1963; Monniot and Monniot 2001). The larval trunk of *S. cerebriformis* is 0.8–1.1 mm long with the tail wound more than once around it, the tail fin extending the encirclement to one and a quarter times around the trunk. Buds have not been detected in the larval trunk of *S. cerebriformis*. These differences in the zooids and larvae reinforce the more significant difference in the growth pattern and shape of the mature colonies, which, in addition to differences in the number of stigmata, Tokioka (1952) recognised as distinguishing the Arafura Sea specimens from other (well) known and well documented species of this genus including *Aplide cerebriforme* Quoy and Gaimard, 1834. Monniot and Monniot's concluding sentence (2001: 261) in their discussion of this species is both irrelevant and certainly untrue.

Monniot (1988) may have overlooked accounts of other species of this genus when she assigned New Caledonian specimens of the present species to the Antarctic species *Sycozoa sigillinoides*.

The white opaque material along the upper surface of some of the living colonies (NTM E164; Fig. 22A) was not detected in preserved specimens, in which the test is translucent.

Hypodistoma deerratum Sluiter, 1895

(Figs 23A, B)

Distoma deerrata Sluiter, 1895: 167.

Hypodistoma deerratum - Kott 1990a: 106 and synonymy. - Monniot and Monniot 2001: 249.

Records. *New records*: Northern Territory (Darwin, Plater Rock, Mandorah Jetty, NTM E167, E209, E216). *Previously recorded* (see Kott 1990a, Monniot and Monniot 2001): NW Australia, NE Australia, Northern Territory, Torres Strait, Philippines, Papua New Guinea.

Remarks. This species is commonly recorded from northern Australian waters, but records from other parts of the western Pacific are not as common. It is found in inter-reefal benthic habitats.

Family Polycitoridae

Polycitor circes Michaelsen, 1930

(Figs 5A,B, 23C,D)

Polycitor circes Michaelsen, 1930: 495. - Kott 1990a: 169 and synonymy. - Monniot and Monniot 1996: 184. - Monniot and Monniot 2001: 249.

Records. *New records*: Northern Territory (Darwin, Plater Rock, Mandorah Jetty, NTM E172, E179, E180, E215). *Previously recorded* (see Kott 1990a, Monniot and Monniot 2001): NW Australia, N. Great Barrier Reef, New Caledonia, Philippines, Indonesia, Papua New Guinea.

Description. Colonies are up to 9 cm tall and consist of a spherical head to 4 cm diameter on a fleshy stalk of lesser diameter. Sometimes more than one stalked head arises from a basal common stalk. The test is firm, gelatinous, translucent in the head but more opaque in the stalk. Generally the test is whitish, but in several specimens brown spots of various sizes (Fig. 23C, D), formed by patches of fine pigment particles in the

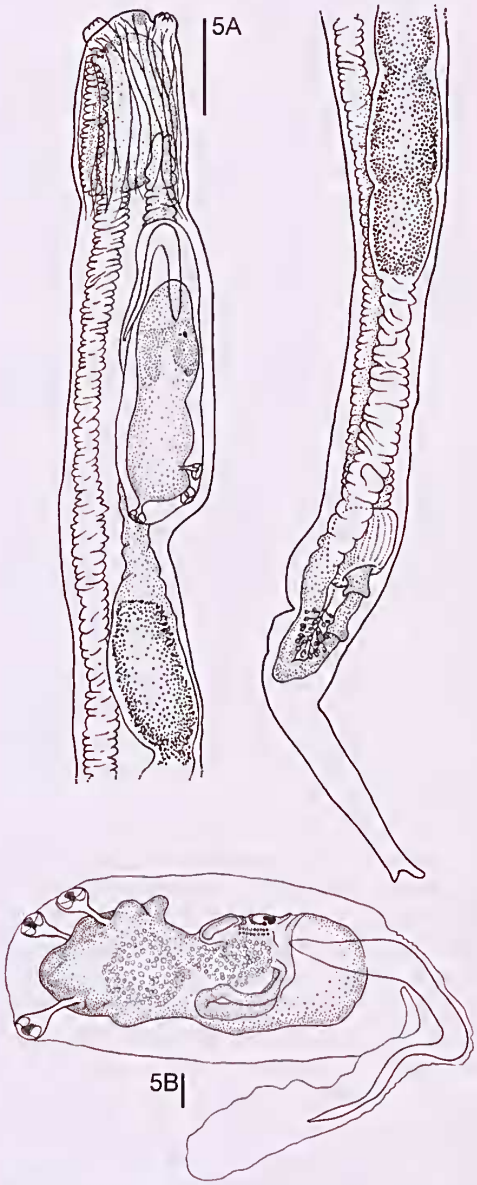

Fig. 5. *Polycitor circes*: **A**, (NTM E180) zooid; **B**, (NTM E179) larva. Scale bars: **A**, 1.0 mm; **B**, 0.2 mm.

surface test, are on the head. Zooids, even when strongly contracted, are 2 cm or more long, most of the length being a long oesophageal neck with oesophagus and rectum gathered into tight folds (Fig. 5A). Strong longitudinal muscles overlie the circular muscles on the thorax, and continue in a strong ventral band down the length of the abdomen. This ventral band of muscles swings dorsally at the posterior end of the abdomen. The small stomach, in the posterior end of the abdomen has 12 –15 fine longitudinal ridges in the internal wall. Externally the stomach wall is smooth. The abdomen terminates in a short delicate, branched, vascular stolon.

A large larva is incubating at the top of the oesophageal neck in specimens taken July to September. One to three embryos are found developing at various levels up the oesophageal neck. The posterior end of the long (to 3 mm) narrow, larval trunk is uppermost. The short tail extends only halfway along the ventral surface of the trunk. The ocellus and small otolith are conspicuous not far from the base of the tail and two rows of stigmata can be detected in the larval pharynx. The anterior end of the trunk is produced into three rounded protuberances that alternate with the three triradially arranged adhesive organs, each with a small short-stalked, disc-like knob of adhesive cells in a shallow epidermal cup.

Remarks. It is clear from all accounts that the embryos, fertilised at the base of the abdomen, develop as they move up the long oesophageal neck.

Some of the present colonies have pigment patches that have not previously been recorded, although otherwise these stalked mushroom-like colonies are characteristic. The blue pigment Kott (1990a) reported in the zooids does not occur in the newly recorded, preserved specimens.

The circular systems Monniot and Monniot (1996) referred to were not detected. The correct reference to the synonymy of this species is in Kott (1990a), not Monniot and Monniot (1996).

Eudistoma eboreum Kott, 1990

(Figs 23E,F)

Eudistoma eboreum Kott, 1990a: 205.

Records. *New records*: Northern Territory (Darwin, Plater Rock, Mandorah Jetty, NTM E187–8, E213). *Previously recorded* (see Kott 1990a): Queensland (near Lizard Island).

Description. Colonies are firm, irregular, gelatinous cushions with the margins sometimes produced into shallow lobes, grey or greyish-white in life. Spherical brown cells are scattered through the test of one (NTM E187) of the specimens and is in the surface test around the apertures in preserved material.

The stellate apertures are all ringed in white, up to 10 branchial ones in an outer circle and the atrial openings close together in the centre of the circle. Atrial siphons are long. Zooids are contracted but have a long oesophageal neck. The proximal part of the rectum is kinked as a result of muscle contraction.

Remarks. Although these colonies have circular systems, they lack the rudimentary common cloaca found in many species of this genus. They also lack the pigmentation and the included sand of otherwise similar species.

Eudistoma superlatum Kott, 1990

(Fig. 23G)

Eudistoma superlatum Kott, 1990a: 229.

Records. *New records*: Northern Territory (Darwin, East Point, NTM E156). *Previously recorded* (see Kott 1990a): NW Australia, Shark Bay, Houtman Abrolhos, Montebello Islands.

Description. This vertical flattened, tongue-shaped colony about 6 cm high has a translucent test, cloudy with pinkish-beige cells and a white suspension in the vicinity of the common cloacal apertures. Sand is embedded in the base and extends up into the centre of the lobe. Zooids, up to 1.5 cm long even when contracted, are arranged in circular systems with atrial apertures opening in the centre. The thoracic longitudinal thoracic muscles converge into a band each side of the long abdomen. Eleven transverse muscles are present beneath the more crowded longitudinal ones. Both conspicuous, long siphons have sphincter muscles behind the six-lobed apertures. Stigmata (about 20 per row) are long and rectangular and those in the anterior row extend anteriorly along each side of the mid-dorsal line. Ventrally, the stigmata are reduced in length each side of the endostyle. The small, almost spherical, stomach is at the posterior end of the zooid.

Remarks. Kott (1990a) did not detect the circular systems in the preserved colony. The deflection of the anterior row of stigmata along each side of the dorsal line is a distinctive feature of this species.

Cystodytes philippinensis Herdman, 1886

(Fig. 23H)

Cystodytes philippinensis Herdman, 1886: 140. - Kott in press and synonymy.

Records. *New records*: Northern Territory (Darwin, East Point, NTM E157). *Previously recorded* (see Kott in press): Queensland (Heron Island, Swain Reefs), Palau Islands, Philippines, French Polynesia, Maldives.

Description: As with all described material, the newly recorded specimen is grey with white blotches on the surface. In preservative, it has flecks of brown/tan pigment evenly scattered throughout the firm, translucent test. Globular spicules are in crowded patches around the cloacal depressions in the surface, but are not crowded throughout as sometimes they are.

Family Polyclinidae

Synoicum macroglossum (Hartmeyer, 1919)

(Figs 24A,B)

Macroclinum macroglossum Hartmeyer, 1919: 126.

Synoicum macroglossum - Kott 1992a: 494. - Kott in press.

Records. *New records*: Northern Territory (Darwin, Plater Rock, Iron Ore Jetty, NTM E168, E202). *Previously recorded* (see Kott 1992a): W and NE Australia.

Description. The colony is a sandy cushion with crowded thread-like zooids in crowded double row systems. Zooids have a large atrial tongue from the body wall in front of the atrial aperture, and a small smooth stomach. A dorsal papilla behind the atrial aperture was not detected in contracted zooids (NTM E168). In less contracted zooids (NTM E202) 12–14 rows of 14 stigmata per row, their length reducing at each end of the rows, were counted. The sand encrusting the outside of the colony is less crowded on the upper surface. Internally there is no sand and the zooids are crowded in the thin translucent test.

Aplidium grisiatum Kott, 1998

(Figs 6A,B, 24C)

Aplidium griseum Kott, 1992a: 551.

Aplidium grisiatum Kott, 1998: 119. - Monniot and Monniot 2001: 208.

Records. *New records*: Northern Territory (Darwin, off East Point, NTM E151). *Previously recorded* (see Kott 1992a, Monniot and Monniot 2001): Queensland (S. Great Barrier Reef), Palau Islands.

Description. The newly recorded colony is an irregular, upright almost cylindrical column about 7 cm high, to 3 cm wide across the expanded top of the column and narrowing toward the base. The top of the colony is gelatinous and free of sand externally and internally. The upper surface is elevated into rounded ridges that surround depressions containing the branchial apertures of zooids arranged in circles, each circle around a central common cloacal opening. In the preserved specimens these opening are emphasised by brown pigment concentrated around them. Usually two or three systems open into each depression. In the remainder of the colony the long threadlike zooids criss-cross each other amongst the sand particles which are crowded throughout and encrust the surface. The anterior part of the thorax is produced up to form a cone at the base of the relatively short but muscular branchial siphon. The rim of each branchial aperture is divided into six distinct rounded lobes. A large muscular, undivided, pointed atrial tongue projects from the body wall just anterior to a circular atrial opening on a short siphon opposite the second row of stigmata. Stigmata are in 15 rows of about 15 per row,

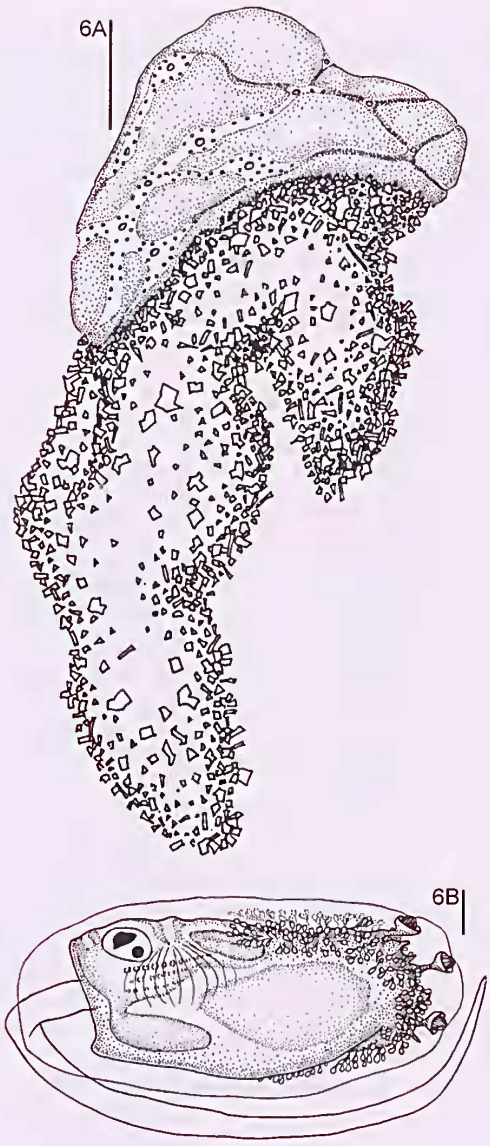

Fig. 6. *Aplidium grisiatum* (NTM E151): **A**, colony; **B**, larva. Scale bars: **A**, 1.0 cm; **B**, 0.1 mm.

their length much reduced ventrally. The anus opens about halfway down the branchial sac. The short stomach, about halfway down the abdomen, has eight longitudinal folds. The gonads occupy only the posterior one-third or less of the long, narrow abdomen. They consist of two or three eggs anterior to two series of testis follicles. In many of the zooids one or two long embryos are lined up in the atrial cavity, the most advanced being anterior to the other. In the newly recorded specimens collected in September the larval trunk is 1.00 mm long, cigar-shaped, with the tail wound halfway around it. Three rows of stigmata and about 12 fine longitudinal muscles are on each side of the thorax.

Remarks. The zooids and larvae are identical with those previously assigned to this species although the upright colony is larger than Kott's (1992a) material and different from Monniot and Monniot's (2001) encrusting (1.0 cm thick) colony.

Monniot and Monniot (2001: 208) refer to meandriform systems, well isolated from each other, each with a central common cloacal aperture. However, although the depressions in the surface test certainly are meandriform in the present colony, the systems themselves are not. Also, sand outlines the depressions in the gelatinous surface in previously recorded colonies but not in the present one.

Sufficient material has been recorded to establish the characteristics of this species: viz. zooids open into the depressions between rounded ridges in the upper surface; sand is embedded in the basal test; zooids are thread-like with short protuberant branchial apertures, a pointed atrial tongue from the body wall anterior to a short atrial siphon, about 15 rows of about 14 stigmata, eight stomach folds, and gonads in the posterior third of the posterior abdomen; and the larval trunk is large, cigar-shaped with ectodermal vesicles in a wide band around the anterior two-thirds on each side of the midline.

Aplidium multiplicatum Sluiter, 1909

(Fig. 24D)

Aplidium multiplicatum Sluiter, 1909: 56. - Kott 1992a: 567 and synonymy. - Kott in press and synonymy.

Records. *New records*: Northern Territory (Darwin, Plater Rock, NTM E169, E181). *Previously recorded* (see Kott 1992a): NW and NE Australia, southern Australia, western Pacific and Hong Kong.

Remarks. The newly recorded colonies (Fig. 24D) are characteristically soft with zooids opening along each side of branched common cloacal canals. They have the usual white deposit around the branchial apertures of the preserved specimens (Kott 1992a).

Family Didemnidae

Leptoclinides aciculus Kott, 2001

(Figs 7A,B, 19A, 24E)

Leptoclinides aciculus Kott, 2001: 37.

Leptoclinides madara - Monniot and Monniot 2001: 288.

Records. *New records*: Northern Territory (Darwin, Navy Base rock wall, Plater Rock, NTM E159, E166 E185. *Previously recorded* (see Kott 2001; Monniot and Monniot 2001): Western Australia (Port Hedland), Papua New Guinea, Palau Islands, Philippines.

Description. Colonies are flat sheets with clumps of zooids surrounded by deep primary common cloacal canals. Large sessile common cloacal apertures with a rim of spicule-free test are at some junctions of circular primary common cloacal canals. Sometimes the colony surface over common cloacal canals is grey owing to the shallow depth of spicules in the relatively thin surface test. Superficially, spicules are mixed with bladder cells, crowded in minute surface papillae (see NTM E166) and around branchial apertures, evenly spaced but not crowded in the upper half of the colony and sparse or absent entirely from the base. Pigment cells are mixed with spicules in the roof and base of common cloacal canals. Spicules are stellate, to 0.096 mm diameter, with 11–13 long, chisel-shaped rays in optical transverse section. The ray length/spicule diameter ratio is to 0.33. In life, colonies are white with orange flecks (NTM E185) or cream with orange pigment over the common cloacal canals.

Zooids have a short branchial siphon, posteriorly directed atrial siphon, nine stigmata in the anterior row of the branchial sac (Fig. 7A); and seven coils of vas deferens around 4–7 testis follicles. Larvae, present in September (NTM E166), have a trunk up to 0.7 mm long, with three pairs of ectodermal ampullae.

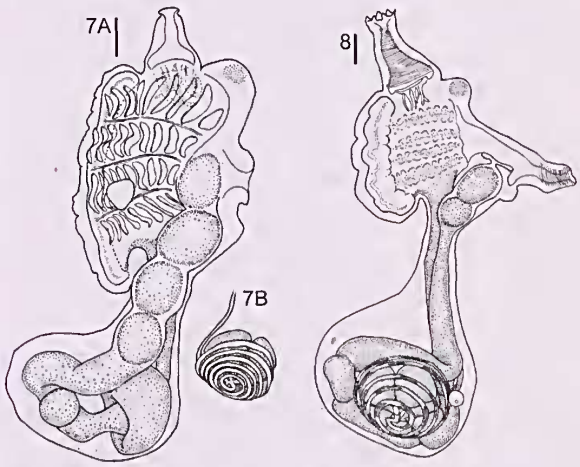

Fig. 7. *Leptoclinides aciculus*: A, (NTM E159) whole zooid; B, (NTM E166) gonad. Scale bar: 0.1 mm.

Fig. 8. *Leptoclinides complexus* sp. nov. (NTM E13, holotype): zooid. Scale bar: 0.1 mm.

Remarks. The relatively sparse spicules, long chisel-shaped spicule-rays, together with the deep (but not posterior-abdominal) cloacal cavities and seven coils of the vas deferens distinguish this species. The newly recorded specimens have only nine stigmata in the first row of the branchial sac although 12 were recorded for the holotype. *Leptoclinides madara* Tokioka, 1953 from the Japan Sea and Sagami Bay (see also Nishikawa 1990), to which Monniot and Monniot (2001) assigned many specimens (of the present species) from the tropical western Pacific, has a similar larva but significantly smaller spicules (to 0.055 mm; Nishikawa 1990) and sometimes mulberry-like spicule rays. The spicule rays are never chisel-shaped as they are in the present species.

Leptoclinides complexus **sp. nov.**

(Figs 8, 19B)

Records. *Type locality:* Northern Territory (Table Head, Port Essington, coll. J. Hooper, 4 May 1982, holotype NTM E13; paratype NTM E12).

Description. In preservative, the holotype colony is a hard complex mass, dark purple externally and paler internally. External surfaces are enclosed by folding and fusing of the colony surface and most openings are secondary ones to enclosed outer surfaces. Common cloacal apertures are terminal on elevations of the surface, sometimes on parts of the colony elevated by the substrate. Dark pigment is in irregular masses in the base of colony, and is mixed with a thin layer of spicules beneath the spicule-free superficial layer of test. A thin (single) layer of spicules also lines the posterior abdominal common cloacal cavities. The paratype colony has a similar distribution of pigment as the holotype but is a single fleshy sheet encrusting an irregular substrate.

Spicules are stellate or mulberry-like (with short rounded rays). Stellate spicules are the larger ones – to 0.05 mm diameter, with 11–13 conical sharply pointed rays in optical transverse section.

Zooids are large, with a distinct branchial siphon, posteriorly oriented atrial siphon, four rows of stigmata, six coils of the vas deferens around 5–7 testis follicles and the post-pyloric part of the gut loop bent at right angles to the longitudinal axis of the zooid. Larvae, in the basal test of the holotype, have a trunk nearly 0.7 mm long but, apart from the tail, otolith and ocellus, the larval organs are not developed.

Remarks. The distribution of spicules, confined to a surface layer and a thin layer lining the common cloacal cavity, is not unusual in this genus (e.g. *dubius* group). However, mulberry-like spicules are an unusual feature in *Leptoclinides*, although similar ones occur in *L. comitus* (which lacks the stellate spicules).

The species' name refers to the complexity of the colony.

Polysyncraton arafurensis **Tokioka, 1952**

Didemnum (Polysyncraton) arafurensis Tokioka, 1952: 91.

Polysyncraton arafurensis - Kott 2001: 93 (part, not specimen QM G302266 from Heron Island, ? *P. regulum* Kott, 2001).

Records. *New records*: Northern Territory (Darwin, NTM E225). *Previously recorded* (see Kott 2001): Western Australia (Dongara), Arafura Sea.

Description. The newly recorded colony is a thin, hard, irregular sheet, crowded with stellate spicules and with a thin, horizontal, common cloacal cavity. The colony, spicules and zooids resemble those previously described. In particular, the atrial tongue from the upper rim of the opening is usually short, thin and often bidentate at the tip (see Tokioka 1952: fig.1). Almost spherical embryos (to 0.6 mm long) are present in the newly recorded colony, but although the tail (wound three quarters of the way around the embryo) and a sensory vesicle with ocellus and otolith are present, other larval organs are not developed and are not known for this species.

Polysyncraton cuculliferum **(Sluiter, 1909)**

(Figs 9, 19C, 24F)

Diplosomoides cuculliferum Sluiter, 1909: 90.

Not *Didemnum cuculliferum* - Kott 1981: 164. – Kott 2001: 167. - Monniot and Monniot 2001: 267.

Polysyncraton echinatum Kott, 2001:101.

Records. *New records*: Northern Territory (Darwin, Plater Rock, NTM E174). *Previously recorded* (see Kott 2001): Queensland (Heron Island to Lizard Island), Indonesia (Sluiter 1909, holotype ZMA TU490).

Description. Fleshy colony growing over shell and bryozoan fragments with some vertical lobes projecting from the upper surface, each with a terminal common cloacal opening. Spicules are in a thin surface layer but are sparse or absent elsewhere. Spicules are stellate, to 0.057 mm diameter with 9–11 strong conical rays. The large, deep, common cloacal cavity extends the whole depth of the zooids. Both surface and basal test layers are thin. Around the outer margins of the colony, a hollow, pointed projection of the test accommodates a long, pointed ventral branchial lobe. Zooids are large with eight stigmata in the anterior row of the branchial sac. Longitudinal thoracic muscles are fine, and narrow transverse pharyngeal muscles between rows of stigmata are conspicuous. A retractor muscle was not detected but an anterior atrial lip usually is present. There is a roomy, open gut loop, 5–7 testis follicles are surrounded by four loose coils of the vas deferens, the outside loop encircling a two or three egg ovary.

The newly recorded specimen, collected in September, has well developed larvae in the basal test with eight ectodermal ampullae on each side of three antero-median adhesive organs and an external ampulla on the left projecting upwards rather than horizontally. The oozooid has a vertical gut loop and four rows of stigmata. Two thoracic blastozooids are in the trunk on the left side of the long oesophageal neck. The tail winds three-quarters of the way around the trunk.

Remarks. Sluiter (1909) described the male gonads of this species as having two testis follicles and a straight vas deferens. Kott (1981) accepted Sluiter's description of the testis and overlooked the fact that the holotype had more than two follicles, although she found the coiled vas deferens and assigned the species

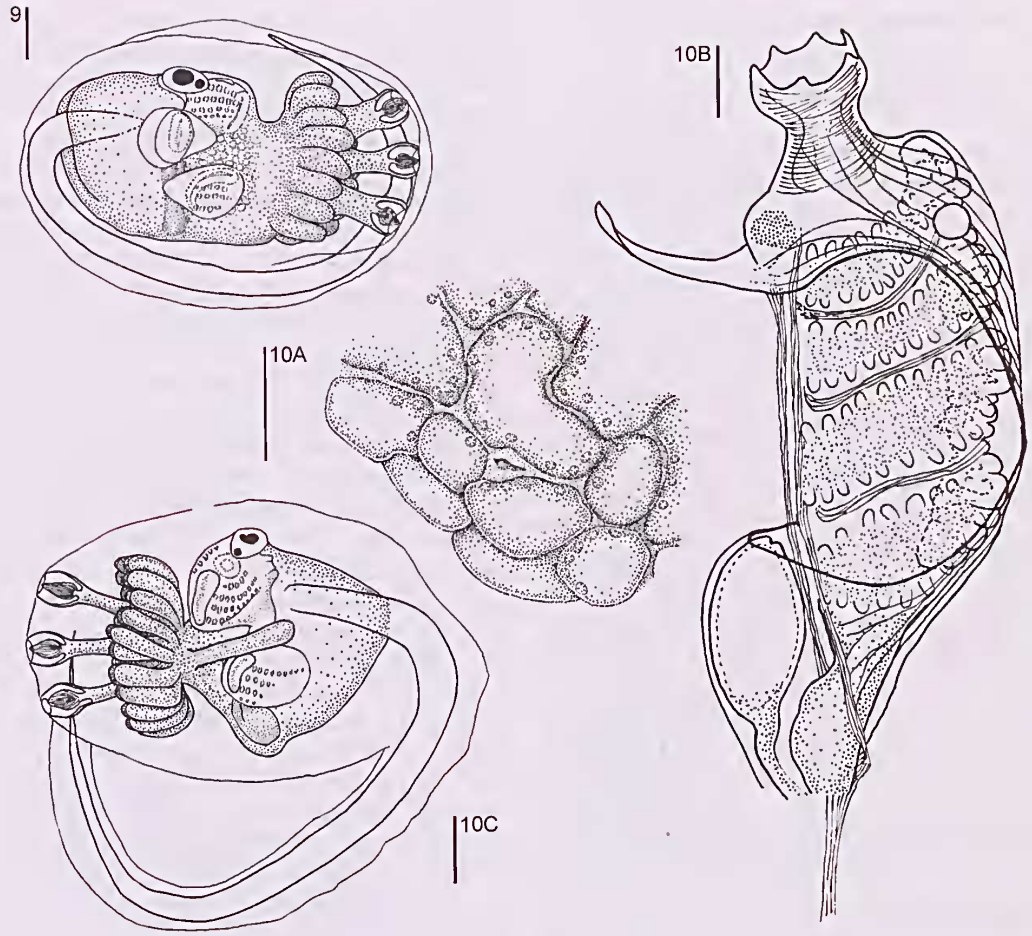

Fig. 9. *Polysyncraton cuculliferum* (NTM E174): larva. Scale bar: 0.1 mm.

Fig. 10. *Polysyncraton dromide* (NTM E211): **A**, colony; **B**, thorax; **C**, larva. Scale bars: **A**, 5.0 mm; **B**. 0.1 mm.

to the genus *Didemnum* (as the senior synonym of those species with a similar large ventral branchial lobe inserted into a hollow pointed surface papilla).

Further, spicules from the Fijian material (Kott 1981) are in the same size range as spicules of the holotype of *Polysyncraton cuculliferum*. However, although Kott (1981) claimed they were, they are not the same shape. Scanning electron micrographs of spicules of the type specimen of *P. cuculliferum* and of *P. echinatum* Kott, 2001 show them to be identical. The colonies also are similar, with vast common cloacal spaces and the spicules crowded in the surface and sparse elsewhere. The large zooids, with roomy branchial sac and gut loop, also are identical and in both cases are difficult to remove from the test. They have similar fine muscles, lack a retractor muscle and have an atrial lip of varying length.

Larvae in the newly recorded specimen are the most advanced known for this species. They are characteristic of many *Polysyncraton* species (and some *Didemnum*), each of four primary ectodermal ampullae dividing into two, and with blastozooids. The oozooid is characteristic of the genus, with four rows of stigmata.

Kott (2001) also had assigned *Didemnum turritum* Michaelsen, 1930 from Western Australia to *Didemnum cuculliferum*, but although the colonies and zooids are small and lack gonads, examination of the small syntype colonies of *D. turritum* (ZMH T1701) shows the spicules to be identical with *D. membranaceum* Sluiter, 1909.

The other specimens Kott (1981, 2001) assigned to *D. cuculliferum* appear to be *Didemnum nekozita* Tokioka, 1967, having small colonies with smaller (0.04 mm diameter) spicules with 5–7 rod-like rays crowded throughout and occasional large (to 0.075 mm diameter) spicules with 4–6 long spiky rays, smaller thoraces with no more than seven stigmata per row, a distinct retractor muscle, no atrial tongue, eight coils of the vas deferens and larvae with four pairs of lateral ampullae and without blastozooids.

Polysyncraton dromide Kott, 2001

(Figs 10A–C, 19D, 24G)

Polysyncraton dromide Kott, 2001: 99 (part, holotype).

Records: *New records*: Northern Territory (Darwin, off East Point, Mandorah Jetty, NTM E154, E211). *Previously recorded* (see Kott 2001): Torres Strait, ?Western Australia (Cockburn Sound).

Description. Translucent fleshy colony encrusting debris (NTM E154) or elevated lobes with terminal common cloacal apertures (NTM E211). Surface quilted (Figs 10A, 24G), with a mosaic of rounded sometimes spicule-free swellings surrounded by deep depressions over the circular common cloacal canals, which are lined on each side by zooids. The common cloacal apertures are in these deep depressions at the junctions of common cloacal canals. Burr-shaped spicules, to 0.05 mm diameter with 13–15 rays in optical transverse section, are in a single layer or in clumps beneath a superficial bladder cell layer where they are mixed with pigment. They sometimes are present only over the common cloacal canals, and occasionally they surround the thoraces. Spicules are absent from the remainder of the test. The common cloacal canals are the full depth of the zooids but are not posterior abdominal. The test is firm and gelatinous. In life, the colonies have a bright, metallic sheen.

Zooids have a trumpet-shaped branchial siphon with pointed lobes around the aperture, a sharply bifid but not long atrial lip, a robust to long and fine retractor muscle, 10–12 testis follicles and four coils of the vas deferens. The body wall has conspicuous projecting pointed columnar epidermal cells (see Kott 2001).

Larvae in specimens collected in September (NTM E154) and July (NTM E211) have a trunk 1.3 mm long with 10 ectodermal ampullae per side. Four rows of at least 10 stigmata are in the oozooid and in the large thoracic blastozooids. One of the blastozooids is halfway down on the right of the oozooid and another is on the left side of the oozooid abdomen. A conspicuous external horizontal ampulla also is on the left between blastozooid and oozooid. A narrow waist separates the base of the circle of lateral larval ampullae and the oozooid. The three deep, antero-median adhesive organs have narrow stalks and pyriform axial cones. The tail is wound halfway around the trunk. The large number of ectodermal ampullae result from subdivision of four broad primary ampullae, the middle ones on each side dividing into three. Large bladder cells are packed in the larval test.

Remarks. Characteristic of this species are its firm test, burr-shaped spicules in a thin layer beneath a superficial bladder cell layer but absent from the remainder of the test, regular circular common cloacal canals forming a quilted surface pattern, large larvae (1.3–1.5 mm trunk) with two thoracic blastozooids and 10–12 ectodermal ampullae per side, and large zooids with a long retractor muscle and relatively short bifid atrial tongue.

On reexamination, the holotype has been found to have four coils of the vas deferens (rather than the three originally reported) and a large horizontal external ampulla on the left side of the trunk between the oozooid and blastozooid, as in the newly recorded specimens. The specimen from Western Australian (Kott 2001) with a different common cloacal system may not be conspecific.

The largest spicules in the newly recorded colony of the present species are larger than those Kott (2001) recorded and are nearly as large as those in *Polysyncraton purou* Monniot and Monniot,1987. However, the latter species has smaller zooids, lacks an external horizontal ampulla on the left side of the larval trunk, lacks a narrow waist between the circle of lateral ampullae and the middle part of the larval trunk anterior to the oozooid, and, when present, the spicules have pointed rays rather than the blunt-tipped rod-like ones of the present species. The cloacal canals are like those of *P. purou,* and the bladder cells in the larval test of the present species also resemble those in *P. purou* and reported to be in the larval test (body wall, *sic*) of the darkly pigmented Philippine *P. aspiculatum* of Monniot and Monniot (2001), which may be a synonym of *P. purou* (see below).

The suggestion that aspicular (or nearly aspicular) specimens from Australia, the Philippines and South Africa (Monniot and Monniot 2001) are conspecific with *P. aspiculatum* Tokioka, 1949 is discussed below (*P. purou,* Remarks).

Polysyncraton vestiens Monniot and Monniot, 2001 from the Palau Island has spicules of similar form and distribution to the present species but they are smaller (to 0.03 mm diameter), larvae are slightly smaller (0.7 mm long trunk) and the retractor muscle is not present.

Polysyncraton pavimentum Monniot, 1993

(Figs 11A–B, 19E, 24H)

Polysyncraton pavimentum Monniot, 1993: 9. - Kott 2001: 92 and synonymy.

Polysyncraton lithostrotum - Monniot 1993: 4.

Not *Didemnum lithostrotum* Brewin, 1956: 127.

Records. *New records*: Northern Territory (Darwin, Plater Rock, NTM E170). *Previously recorded* (Monniot 1993): New Caledonia, Coral Sea.

Description. Newly recorded colonies are thin, divided into circular to hexagonal systems 5–10 mm diameter, each with a central common cloacal aperture, violet coloured in life surround by opaque, solid, spicule-filled test. Colonies are white in preservative.

Spicules are confined to a surface and a basal layer. They are to 0.08 mm diameter, usually stellate, with 9–11 conical, usually pointed but sometimes round-tipped, rays in optical transverse section. Occasional spicules are almost globular. Primary common cloacal canals are deep with clumps of abdomina either embedded in, or projecting up from, the basal test. Spicules are not present in the ventral thoracic test sheath.

Zooids have cylindrical branchial siphons with six conspicuously pointed lobes around each aperture. Atrial apertures are wide, exposing most of the branchial sac to the common cloacal cavity. They have an atrial tongue of variable length projecting from the anterior rim of the opening. Tapering columnar epithelial cells project from the thoracic body wall. A short retractor muscle projects from the top of the oesophageal neck. Stigmata are obscured by contraction. Gonads are not present in the newly recorded material.

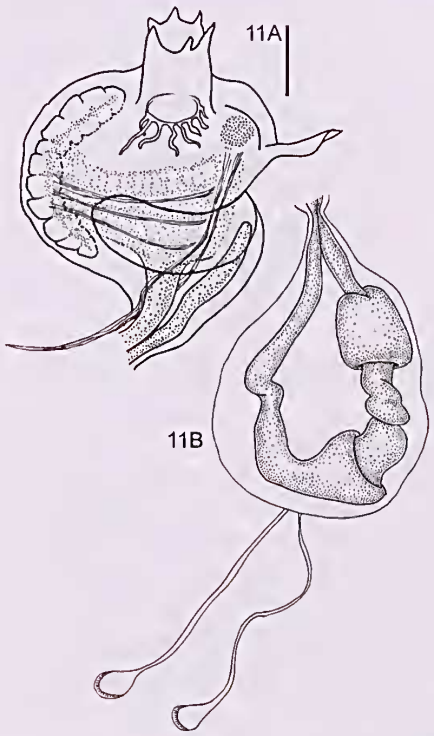

Fig. 11. *Polysyncraton pavimentum* (NTM E170): **A**, zooid; **B**, abdomen. Scale bar: 0.2 mm.

Remarks. Despite the lack of information on the branchial sac, gonads and larvae, the newly recorded colony is exactly like previously described specimens. This record extends the known range of the species, which has not previously been recorded from Australia.

Polysyncraton pseudorugosum Monniot, 1993

(Fig. 19F)

Polysyncraton pseudorugosum Monniot, 1993:10. - Kott 2001:123.

Records. *New records*: Northern Territory (Darwin, NTM E21). *Previously recorded* (see Kott 2001, Monniot 1993): Northern Territory, Torres Strait, Hervey Bay, New Caledonia.

Description. The newly recorded colony has some flattened branches which contain a hard central axis of particularly crowded spicules surrounded by a large common cloacal cavity interrupted by stands of solid test in which the ventral surfaces of thoraces are embedded. Abdomina are only partially embedded in the basal or axial test. Spicules are to 0.09 mm diameter with 9–11 conical pointed rays in optical transverse section. Zooids, with a small retractor muscle, resemble those of previously recorded specimens. Larvae in the newly recorded colony (collected in August) are incubated in the central or basal test and liberated through the common cloacal cavity. They have 12 ectodermal ampullae per side.

Remarks. The cloacal systems, zooids and larvae resemble those previously described. Spicules have a greater diameter than previously reported for this species, but on re-examination, some larger spicules (0.09 mm diameter as in present colony) have been found in a colony from Bathurst Island (QM G302910).

Polysyncraton purou Monniot and Monniot, 1987

(Figs 12A–D)

Polysyncraton purou Monniot and Monniot, 1987: 49. - Kott 2001:126 and synonymy.

Polysyncraton aspiculatum - Monniot and Monniot 2001: 273.

Records. *New records*: Northern Territory (Darwin, NTM E224). *Previously recorded* (see Kott 2001, Monniot and Monniot 2001): Queensland (Heron Island, Mackay, Lizard Island); French Polynesia; Philippines.

Description. The colony is a flat, thin, gelatinous sheet with zooids along each side of the network of surface depressions over the thoracic primary cloacal canals. Common cloacal apertures are sessile and randomly distributed at the junctions of some of these canals. The surface layer of test contains crowded black and tan pigment cells and the colony is blackish-brown and opaque. The remainder of the test is whitish and translucent. The preservative is stained brownish-yellow. Spicules were not detected in this colony.

Zooids are not readily removed from the test. The branchial siphon is relatively short. The atrial aperture is sessile, relatively small, exposing only a small part

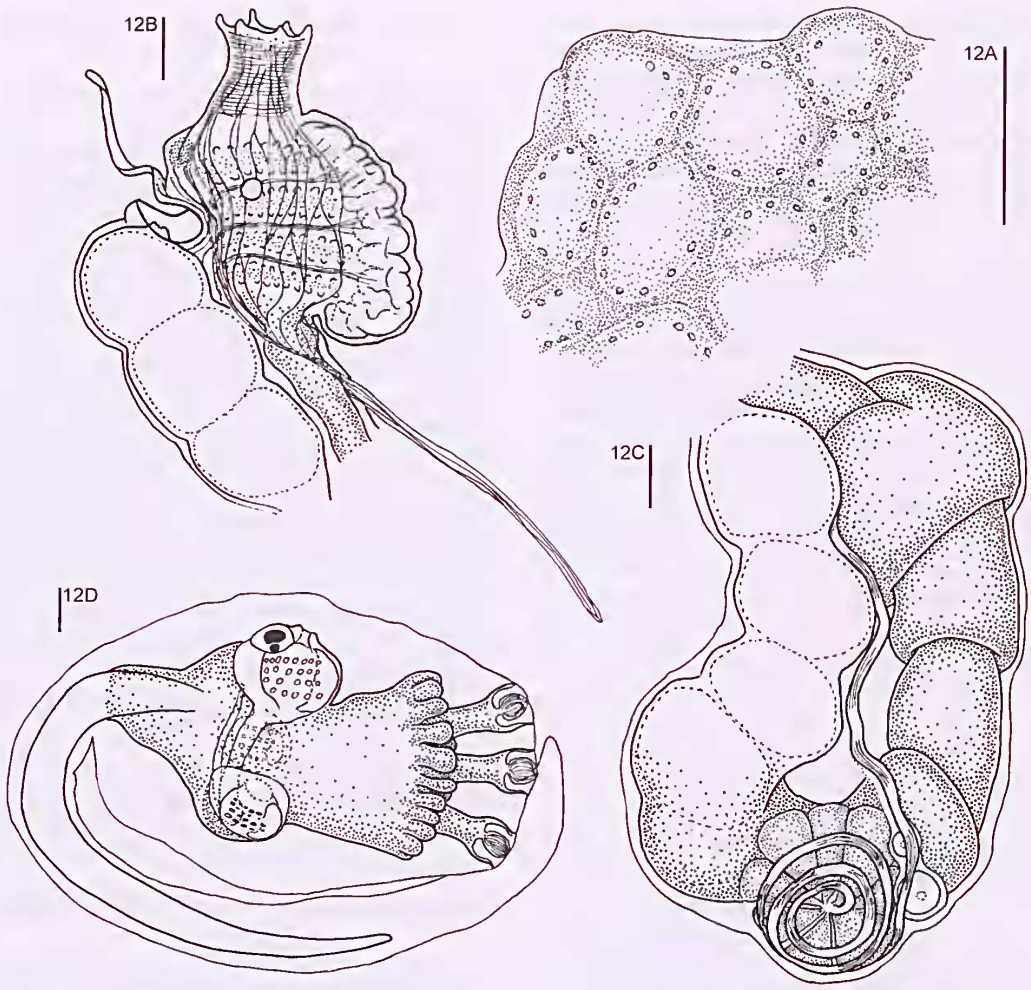

Fig. 12. *Polysyncraton purou* (NTM E224): **A**, colony surface; **B**, thorax; **C**, abdomen; **D**, larva. Scale bars: **A**, 5.0 mm; **B-D**, 0.1 mm.

of the mid-dorsal part of the branchial sac to the atrial cavity. A small atrial lip projects from the anterior rim of the opening. Fine longitudinal muscles are in the parietal wall of the thorax and a small circular lateral organ is antero-ventral to the atrial opening. The branchial sac is wide with about 10 stigmata in the anterior row. A short, robust retractor muscle projects from the anterior half of the oesophageal neck. In the newly recorded specimen a large monstrillid copepod and numerous nauplius larvae are in the gut of each zooid. A circle of four or five testis follicles are against the postero-dorsal part of the gut loop with four coils of the vas deferens, the outer coil enclosing a small ovary containing two small eggs and one larger one.

Embryos are being incubated in the basal test and larvae are liberated through the surface of the colony. The larval trunk is almost 1.4 mm long with the tail wound only halfway around it. Ten ectodermal ampullae are on each side of the three antero-median adhesive organs, the oozooid and two thoracic blastozooids (one halfway down on the left and the other near the base of the gut loop of the oozooid on the right) each have four rows of stigmata. A small external horizontal ampulla on the left between the oozooid and the blastozooid is obscured by the blastozooid in these larvae. The middle part of the larval trunk, between the base of the lateral ampullae and the oozooid is particularly long in this species and the narrow waist that in other species separates the lateral ampullae from the oozooid was not detected. Large bladder cells are packed in the larval test.

Remarks. *Polysyncraton dromide* Kott, 2001, *P. palliolum* Kott, 2001 and *P. pseudorugosum* Monniot, 1993 have similar common cloacal systems and larvae to the present species. The last two species are readily distinguished by their crowded spicules, but the present species and *P. dromide* either have spicules in a patchy layer in the surface test, or completely lacking. When they are present, spicules can be used to distinguish these species, those of *P. dromide* being burr-like with

rod-like rays and those of *P. purou* having pointed rays. When the spicules are absent altogether, as they are in the newly recorded colony, the darkly pigmented surface test, darkly stained preservative and the long middle section of the larval trunk (with an ill-defined waist behind the lateral ampullae and the small inconspicuous external horizontal ampulla on the left) contribute to the identification of the species.

The restricted atrial aperture in zooids of the newly recorded colonies resembles that figured by Kott (2001), although she describes the atrial opening as wide, exposing much of the branchial sac. It is probable that this inconsistency results from different stages in the contraction of the zooids, rather than an actual difference in their morphology. Also, Kott (2001) incorrectly reported the tail of this species wound all the way around the trunk, although the figure shows it to be wound three-quarters of the way around – longer than in the newly recorded colony.

Monniot and Monniot (2001) assigned aspicular and almost aspicular specimens of *Polysyncraton* from Japan, Australia, the Philippines and South Africa to *P. aspiculatum* Tokioka, 1949 (not Tokioka, 1953 as in Kott 2001). However, despite similarities in the zooids, the Japanese species is distinguished from others by its globular spicules to 0.06 mm diameter with needle-like rays (see Nishikawa 1990) and its common cloacal systems – clearly defined systems with zooids along each side of the network of canals – never having been reported for specimens from Japan.

Polysyncraton ? aspiculatum sensu Monniot *et al.* (2001) from South Africa is distinguished from the present species by its white colony, fewer larval lateral ampullae (eight per side), and, when these are present, small (to 0.03 mm diameter) burr-like spicules with rod-like rays (similar to but smaller than those of *P. dromide*) rather than the stellate spicules of the present species. Kott (2001) has discussed the affinites of Australian specimens wrongly assigned to the Japanese species. The completely aspicular darkly pigmented specimen from the Philippines (Monniot and Monniot 2001) has affinities with the present species.

Didemnum clavum Kott, 2001

(Figs 19G, 25A,B)

Didemnum clavum Kott, 2001: 164 and synonymy.

Records. *New records*: Northern Territory (Darwin, off East Point, Navy Base Rock Wall, Plater Rock, NTM E150, E158, E183). *Previously recorded* (see Kott 2001): NW Australia; Queensland (Heron Island, Swain Reefs); Northern Territory (Darwin), Indonesia.

Description. Newly recorded material includes a branching colony (NTM E150) with spicules crowded in a central axis to make a hard axial skeleton. Other specimens are thin sheets encrusting a hard substrate (Fig. 25A). The common cloacal cavity is thoracic. Spicules to (0.06 mm diameter with 5–7 long pointed arms in optical transverse section) are crowded throughout.

Zooids have a particularly long oesophageal neck, the post-pyloric part of the gut loop bent ventrally at right angles to the longitudinal axis of the zooid, and eight coils of the vas deferens.

Remarks. The long oesophageal neck, thoracic common cloacal cavity, hard colony, simple stellate spicules with relatively few, long, pointed arms and numerous vas deferens coils are characteristic of the present species, known to be common in Darwin Harbour.

Didemnum granulatum Tokioka, 1954

(Fig. 25C)

Didemnum (*Didemnum*) *moseleyi* f. *granulatum* Tokioka, 1954: 244.

Didemnum granulatum - Kott 2001 and synonymy: 188.

Records. *New records*: Northern Territory (Darwin, off East Point, NTM E152). Previously recorded (see Kott 2001): NW and NE Australia and Northern Territory, Tokara Island (Japan), Fiji, French Polynesia, Hawaii.

Description. The newly recorded colony (Fig. 25C) from Darwin has crowded stellate spicules, to 0.04 mm diameter, with 7–9 and occasionally 5–11 regular conical rays in optical transverse section. The common cloacal cavity is thoracic and zooids are small with seven stigmata in the anterior row and six coils of the vas deferens.

Remarks. The spicules resemble those of *Didemnum madeleinae* Monniot and Monniot, 2001, but are slightly larger and have a few more rays. They are of similar form to, and the same size as, *D. perplexum* Kott, 2001. Both these species are distinguished from the present one by having more vas deferens coils and larval ectodermal ampullae. The zooids and larvae of *D. algasedens* Monniot and Monniot, 2001 resemble the present species, although its colonies are small translucent cushions and usually its spicules have more rays (9–11) in optical transverse section).

Didemnum madeleinae Monniot and Monniot, 2001

(Figs 13A,B, 19H, 25D–F)

Didemnum madeleinae Monniot and Monniot, 2001: 268.

Records: *New records*: Northern Territory (Darwin, Plater Rock, reef off Charles Point, NTM E178, E184, E203). *Previously recorded* (Monniot and Monniot 2001): Papua New Guinea.

Description. Newly recorded colonies are encrusting sheets about 2 mm thick, pink to orange-red in life and sometimes with a ring of dark reddish pigment around the white-rimmed, randomly

distributed common cloacal apertures. Some traces of orange pigment are in the surface of preserved specimens. Branchial apertures are evenly spaced. Spicules are crowded throughout and are also in the minute papillae on the surface. They are stellate, to 0.045 mm diameter with 5–7 conical rays in optical transverse section. The common cloacal cavity is thoracic.

Zooids are about 1.3 mm long with a long retractor muscle from about halfway down the oesophageal neck. Branchial apertures are short, and cylindrical with six sharply pointed lobes. Stigmata are relatively long, and seven are in the anterior row. The post-pyloric part of the gut loop is bent up ventrally and the testis, with eight coils of the vas deferens, is against its dorsal side. Larvae are not present in the newly recorded specimen but those in the type material have a large trunk (about 1 mm long) containing 12 pairs of ectodermal ampullae around the three antero-median adhesive organs. Although none were detected in the relatively rudimentary larva from the type material, these large trunks with many ectodermal ampullae could contain blastozooids.

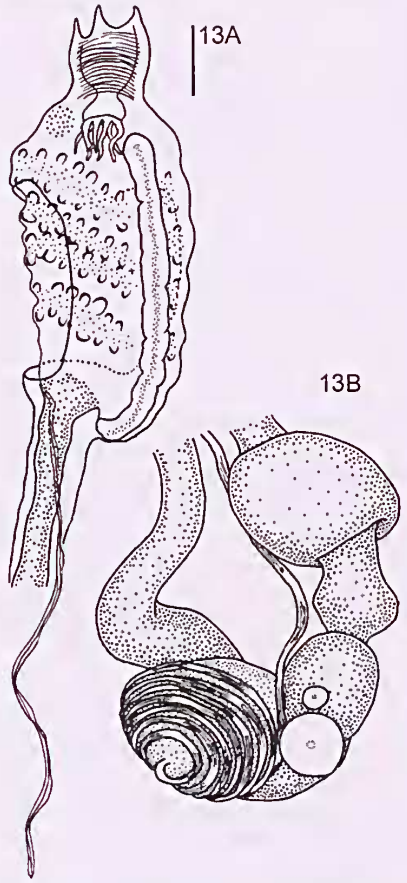

Fig. 13. *Didemnum madeleinae* (NTM E184): **A**, thorax; **B**, abdomen. Scale bar: 0.1 mm.

Remarks. Several living colonies (Fig. 25D, E) resemble a juvenile specimen of *Didemnum multispirale* Kott, 2001 (see Kott 2001: pl. 12A). However, their spicules are identical in size and form with those from the type material of *D. madeleinae* (see Monniot and Monniot 2001: fig. 54A), being relatively small and distinctly stellate with relatively few conical rays. Another colony (NTM E203) is pink. Otherwise the newly recorded colonies are similar to the orange coloured type, although they have lost their colour in preservative. The figured zooid (Monniot and Monniot 2001: fig. 53) has eight coils of the vas deferens like the present specimens, but only seven coils are reported in the type.

The spicules are similar to, but smaller than, those of *Didemnum perplexum* Kott, 2001 and *D. granulatum*, the larvae have more numerous ectodermal ampullae, and there are more coils of the vas deferens (seven in *D. perplexum* and six in *D. granulatum*). *Didemnum captivum* Monniot and Monniot, 1997, from Tanzania, is similar to the present species, distinguished only by its smaller larval trunk and fewer ectodermal ampullae.

Didemnum membranaceum Sluiter, 1909

(Fig. 20A)

Diplosomoides membranaceum Sluiter, 1909: 58. - Kott 2001: 205 and synonymy.

Didemnum turritum Michaelsen, 1930: 521.

Records: *New records*: Northern Territory (Darwin, Plater Rock, NTM E165). *Previously recorded* (see Kott 2001): NE and NW Australia, Timor Sea, Andaman Sea, Indonesia, Micronesia, French Polynesia, Hong Kong.

Description. Although gonads were not detected in the newly recorded colony, it is the characteristic thin encrusting sheet with small zooids, shallow thoracic common cloacal cavity and crowded stellate spicules with pointed conical rays (including occasional giant spicules). In life it is red with raised white areas where the spicules crowd out the pigment.

The syntypes (ZMH T1701) of *Didemnum turritum* Michaelsen, 1930 from Shark Bay (WA), have been reexamined. These small, thin colonies, like some of the present species, usually have rows of pointed surface processes, one associated with each branchial aperture as is characteristic of *Polysyncraton cuculliferum*, *Didemnum nekozita* and other species (see Kott 2001). Spicules (which are crowded throughout) are also like those of the present species, the majority being stellate, with 7–11 long, sharply pointed, conical rays up to 0.05 mm diameter, and some randomly distributed large (to 0.08 mm diameter) six-rayed spicules. The small zooids with comma-shaped thoraces and up to six stigmata in the anterior row (see Kott 2001: fig. 98B, C) also are similar to the present species. Gonads were not detected. This species appears to be a junior synonym of *D. membranaceum*.

Didemnum algasedens Monniot and Monniot, 2001 has small (to 2.5 cm diameter and only 1 mm thick) colonies and spicules like the smaller ones in the present species. However, the larger tetrahedral to 6-rayed spicules characteristic of the present species have not been reported and the there are said to be eight (rather than six) coils of the vas deferens.

Didemnum molle (Herdman, 1886)

Diplosomoides molle Herdman, 1886: 310.

Didemnum molle - Kott 2001: 208 and synonymy. - Monniot *et al.* 2001: 51.

Records. *New records*: Northern Territory (Darwin, Mandorah Jetty, NTM E217). *Previously recorded* (see Kott 2001, Monniot *et al.* 2001): Indo-west Pacific, from W Indian Ocean to Okinawa, Vietnam and Fiji. Although Monniot *et al.* (2001) claim that the record of the species from coralline habitats on the African coast north of Durban (29° 85'S) is the most southerly for this species, it was recorded from the Western Australian coast in Cockburn Sound (32° 10'S) and Esperance (33° 45'S) by Kott (1977, 2001).

Remarks. The abundant mucus referred to by Monniot *et al.* (2001) is secreted and liberated from the colony following disturbances. It is not normally contained in the colony (see Kott 1980). The extensive synonymy for this species is documented by Kott (1977, 1980 and 2001) rather than Monniot (1994).

Didemnum parau Monniot and Monniot, 1987

(Figs 14A,B, 20B, 25G)

Didemnum parau Monniot and Monniot, 1987: 39.

Records. *New records*: Northern Territory (Darwin, off East Point, NTM E153). *Previously recorded* (see Kott 2001, Monniot and Monniot 1987): French Polynesia, Philippines.

Description. White when living, the newly recorded preserved colony has brown pigment mixed with spicules in the surface. Burr-like to globular spicules, to 0.03 mm diameter, are crowded through the remainder of the test, although they are absent from the fleshy rim of common cloacal apertures. Thoraces are separate from one another and abdomina are partially embedded in the basal test or clumped together in test connectives and surrounded by common cloacal cavity. Spherical black cells are in the test and free of it around the zooids. Zooids have a long thin retractor muscle and seven coils of the vas deferens around an undivided testis.

Remarks. Spicules of the present species resemble those of *Didemnum fragile* and *D. albopunctatum*. The newly recorded colony conforms with previous descriptions of this species, although the spherical brown cells surrounding the zooids (as in *D. fuscum* and *D. sordidum*) have not previously been reported. Refringent morula cells are recorded (Monniot and Monniot 1987).

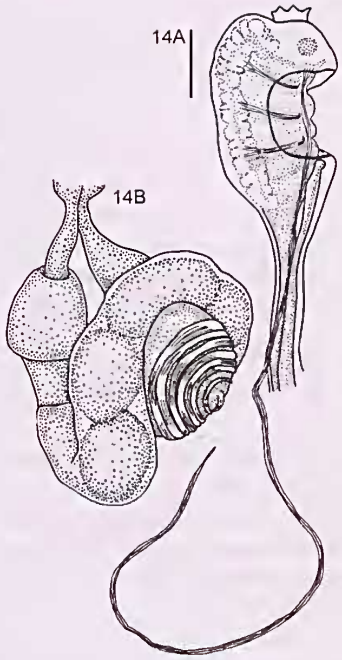

Fig. 14. *Didemnum parau* (NTM E153): **A**, thorax; **B**, abdomen. Scale bar: 0.1 mm.

Didemnum perplexum Kott, 2001

(Figs 20C, 25H)

Didemnum perplexum Kott, 2001: 224 and synonymy.

Records. *New records*: Northern Territory (Darwin, reef off Charles Point, NTM E206). *Previously recorded* (see Kott 2001): Queensland (Capricorn Group, Swain Reefs), New Caledonia, Indonesia.

Description. The newly recorded colony is a soft white encrusting sheet, even on the upper surface but with variations in the thickness of the colony compensating for an irregular substrate. Spicules are crowded throughout but not so crowded that the colony is brittle. In the surface are what appear to be spherical vesicles with ridges of spicule-filled test or small spicule-filled papillae between these vesicles creating an areolar pattern that is interrupted by stellate branchial apertures with their margins lined by spicules. The preserved colony is white with a pinkish tinge.

Spicules are stellate to 0.05 mm diameter with 5–9 long pointed rays in optical transverse section, some distinctly conical but others almost rod-like. A spherical plug of spicules from a large spherical lateral organ opposite the interspace between the third and fourth rows of stigmata is on the edge of the spicule-filled ventral test sheath associated with each thorax as it crosses the deep horizontal common cloacal cavity. The abdomina are embedded in the basal test and only sometimes project up into the floor of the common cloacal cavity.

Zooids lack an atrial lip, have a fine retractor muscle, eight stigmata in the anterior row of the branchial sac, the post-pyloric part of the gut loop flexed ventrally to form a secondary loop and seven coils of the vas deferens surround an undivided testis.

Remarks. Brighter colours have been reported for the type material. However, the newly recorded colony has similar zooids, colonies and spicules and appears to belong to this species. The spicules are similar to, but have longer and some more rod-like rays than the short conical rays of *Didemnum madeleinae*.

Didemnum psammatode (Sluiter, 1895)

(Figs 20D, 26A)

Leptoclinum psamathodes Sluiter, 1895: 171.

Didemnum psammatode - Kott 2001: 229 and synonymy.

Records. *New records*: Northern Territory (Peron Island, QM G303646; Shoal Bay, QM G303655; Darwin, Shore Reef, East Point, Channel Rock, Iron Ore Wharf, reef off Charles Point, NTM E10, E27, E30, E201, E205, E207). *Previously recorded* (see Kott 2001): The species has a wide recorded range in the Indian and Pacific Oceans. It has not been reported from either the Atlantic Ocean or the Mediterranean Sea.

Description. The newly recorded colonies are all large. Some are narrow branching stalks that are thicker toward the base. The maximum stalk diameter is about 1 cm. Sometimes the stalks coalesce and form a reticulum. The centre of each stalk is packed with faecal pellets. Other colonies are encrusting, sometimes with some cylindrical outgrowths from the surface. Spicules sometimes (NTM E30, E205, QM G303655) are crowded in the surface test, forming a continuous layer of white that obscures the grey of the faecal pellets and also may shade the colony. In one of these colonies (QM G303655) spicules also are packed in the ventral test sheath (associated with the thorax crossing the common cloaca) and in the floor of the common cloaca. In several colonies (NTM E201, E207) the spicules are in small patches around the common cloacal and branchial apertures and in a thin veil on the base of the colony. The spicules are mainly burr-shaped, never more than 0.035 mm in diameter but only occasional globular or stellate spicules (as in Kott 2001: fig. 168A) were detected.

Remarks. Complex branched colonies have been reported previously for this species. Spicules crowding the surface test have not previously been reported and generally they appear to be more crowded in large branching colonies, than in sheet-like ones. Nevertheless, spicules are never crowded in either the basal test or the central test of cylindrical branches. In this species the central axis supporting the branches of complex colonies is formed of crowded faecal pellets rather than the packed spicules found in certain species (e.g. *Didemnum clavum* Kott, 2001, *Trididemnum sibogae* Hartmeyer, 1910).

Spicules are all less than 0.037 mm diameter. There is some variation in the extent to which the rays may separate out.

Trididemnum marmoratum (Sluiter, 1909)

(Figs 15A,B, 20E, 26B)

Leptoclinum marmoratum Sluiter,1909: 84.

Records. *New records*: Northern Territory (Gulf of Carpentaria, QM G308587, AIMS 17953. *Previously recorded*: Indonesia (Sluiter 1909).

Description. The colony is fleshy, flattened, with randomly distributed sessile common cloacal apertures and occasional elevated lobes and ridges. The test is firm but gelatinous and translucent. Zooids are in clumps surrounded by deep primary common cloacal cavities that spread into extensive horizontal posterior abdominal spaces interrupted by connectives anchoring zooid clumps to the basal test. Oesophageal spaces penetrate amongst the zooids in each clump. Spicules

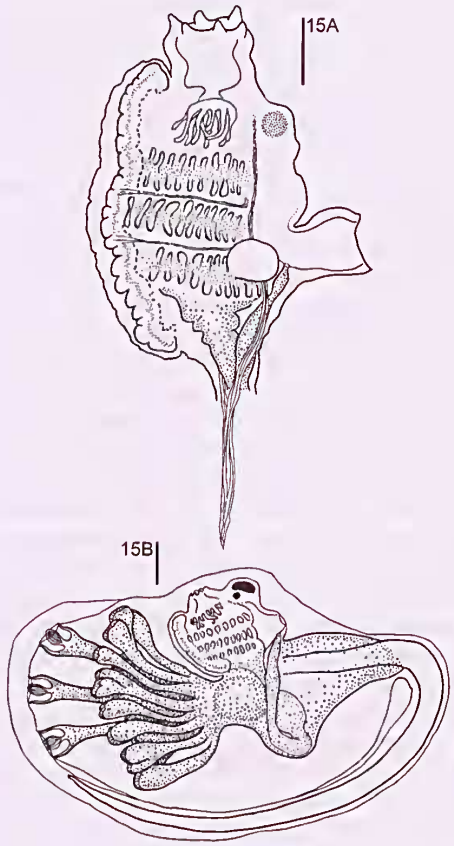

Fig. 15. *Trididemnum marmoratum* (QM G308587): A, thorax; B, larva. Scale bars: 0.1 mm.

are in a crowded layer beneath a superficial spicule-free bladder cell layer and in an even but less crowded layer lining the common cloacal cavity. They are completely absent from the basal test. Spicules are large, stellate, to 0.08 mm diameter, with 9–11 short, strong, conical or chisel-shaped rays in optical transverse section, sometimes with a bifid tip. They break up readily.

Zooids are robust with a short, cylindrical branchial siphon and short posteriorly oriented atrial siphon from the posterior third of the dorsal border. Extensive anterior and posterior imperforate areas are in the pharynx. About 10 stigmata are in each row in the branchial sac. A large, robust retractor muscle projects from the posterior end of the thorax. The gut forms a slightly curved loop, but gonads are not present in this specimen. Large larvae, (taken in February), with the trunk 1 mm long and the tail curved only halfway around it, are numerous in the basal test. Eight long ectodermal ampullae are developed on each side of three antero-median adhesive organs. Ampullae have expanded and curved tips with long epidermal cells along their terminal ends. Both larval and adult organs are well-formed in these larvae.

Remarks. The species has similar firm gelatinous test and larval ectodermal ampullae to *Trididemnum discrepans* (Sluiter, 1909). However, it lacks the black pigment, the black squamous epithelium and the endostylar pigment cap of the latter species and has smaller zooids and fewer stigmata. It is distinguished from other species of *Trididemnum* by its relatively small larval trunk with more ectodermal ampullae. The spicules also are unusual, the wide chisel-shaped to subdivided tips resembling most closely those of the temperate species, *T. cristatum* Kott, 2001 which is distinguished by the absence of posterior abdominal cloacal cavities and its smaller larvae with only four pairs of ectodermal ampullae.

Trididemnum planum Sluiter, 1909

(Figs 16A–C, 20F, 26C)

Trididemnum planum Sluiter, 1909: 42. - Kott 2001: 256.

Records. *New records*: Northern Territory (Darwin, Plater Rock, NTM E191, E192). *Previously recorded* (see Kott 2001): Indonesia.

The species characters are summarised by Kott (2001).

Trididemnum savignii (Herdman, 1886)

(Fig. 26D)

Didemnum savignii Herdman, 1886: 261.

Trididemnum savignii - Kott 2001: 281 and synonymy.

Records. *New records:* Northern Territory (Darwin, Mandorah Jetty, NTM E214). *Previously recorded* (see Kott 2001): NW Australia, NE Australia, Darwin, Indonesia; West Indies.

Description. Colonies are characteristic firm, grey, gelatinous slabs with black pigment cells throughout and a layer of large stellate spicules beneath a superficial layer of bladder cells. Zooids have black squamous epithelium, a long tapering retractor muscle, an endostylar pigment cap, a posteriorly oriented atrial siphon, and eight coils of the vas deferens around an undivided testis.

Trididemnum sibogae (Hartmeyer, 1910)

(Fig. 17)

Didemnum sibogae Hartmeyer, 1910: 1489 (nom. nov. for *Didemnum ramosum* Sluiter, 1901).

Trididemnum sibogae - Kott 2001: 285 and synonymy.

Records. *New records*: Western Australia (? Port Hedland, NTM E35); Northern Territory (Darwin, East Point, NTM E19). *Previously recorded* (see Kott 2001): NW Australia; South Australia; Tasmania; New South Wales; NE Queensland; Gulf of Carpentaria; Indonesia; New Caledonia; Gulf of Manaar.

Description. Newly recorded colonies are spiky, complex, branching lamellae that form three-dimensional reticula (see Kott 2001: fig. 132A). In preservative, one colony (NTM E19) is grey-black, and the other is an opaque pinkish-white. Zooids have black squamous epithelium and an endostylar pigment cap. Extensive common cloacal cavities are posterior abdominal either surrounding a central test core (NTM E35) or occupying the whole centre of the branch or lobe (NTM E19). Spicules with 9–11 spiky rays in optical transverse section are large (to 0.09 mm diameter) in the Darwin specimen (NTM E19) but smaller (to 0.065 mm) in the Port Hedland material. They are crowded throughout, especially where they are packed to form a hard supporting axial skeleton in the central test or along one side of the central common cloacal cavity in the specimen from Darwin. The axial skeleton is continuous, branching with the branching of the colony. Larvae are present only in the Port Hedland specimen (taken in September). They differ from previously recorded material (see Kott 2001) from the Gulf of Carpentaria (QM G303519) and Port Hacking (AM Z5136, QM GH32) in their size – the trunk length, being 0.55 mm (rather than 0.7 mm), and the relative length of the tail (which winds almost the whole way around the trunk rather than halfway).

Remarks. The specimen from Port Hedland has significantly smaller spicules and smaller larvae with a relatively longer tail than the previously reported specimens of this species. Further, it is an unusual opaque pink colour in preservative. Its assignation to this species is in doubt.

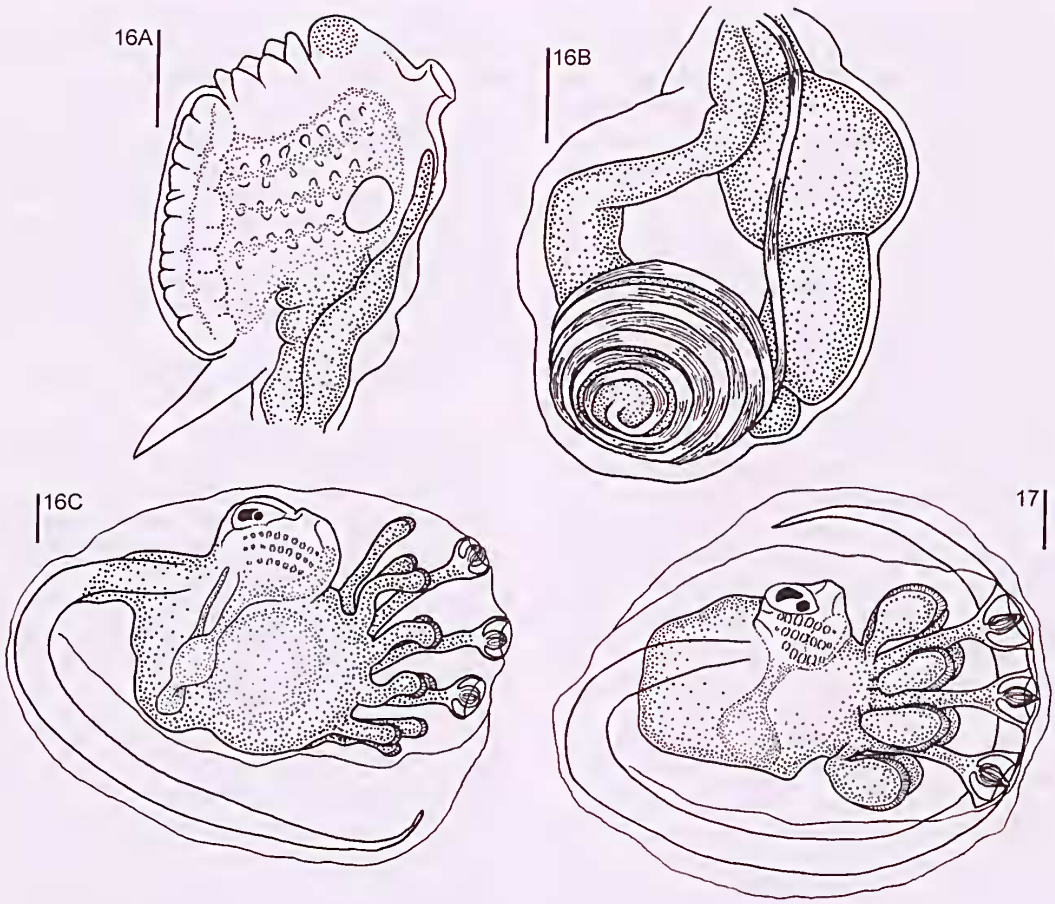

Fig. 16. *Trididemnum planum* (NTM E191): **A**, thorax; **B**, abdomen; **C**, larva. Scale bar: 0.1 mm.

Fig. 17. *Trididemnum sibogae* (NTM E35): larva. Scale bar: 0.1 mm.

Lissoclinum badium Monniot and Monniot, 1996

(Figs 26E–H)

Lissoclinum badium Monniot and Monniot, 1996: 170 - Monniot and Monniot 2001: 282. - Kott 2001: 296.

Records. *New records*: Northern Territory (Darwin, Plater Rock, NTM E173, E186, E190). *Previously recorded* (see Kott 2001, Monniot and Monniot 2001): NW Australia, NE Australia (Capricorn Group to Lizard Island), Coral Sea, Palau Islands, Papua New Guinea.

Description. One newly recorded specimen (NTM E186) conforms with previously described and photographed specimens (see Monniot and Monniot 1996; Kott 2001). The other two have more crowded spicules throughout, including crowded spicules surrounding the zooids in the test connectives and throughout the surface layer of test. Some yellow but not much brown pigment is in the surface test, mixed with the spicules. The living specimens are various shades of cream, yellow to brown, but in preservative the dark vesicles scattered in the test around the zooids and in the haemocoel are conspicuous against the crowded white spicules.

Remarks. The form of the colony, with large common cloacal apertures which, in living specimens, are terminal on elevations resulting from inflation of the common cloacal cavity, are characteristic of this species.

Lissoclinum conchylium Kott, 2001

(Figs 18A, 20G, 27A)

Lissoclinum conchylium Kott, 2001: 350.

Records. *New records*: Northern Territory (Darwin, Plater Rock, NTM E221). *Previously recorded* (see Kott 2001): Queensland (Moreton Bay, Heron Island).

Description. The thin, encrusting colony has the crowded spicules mixed with dark plum-coloured pigment cells in the surface test interrupted by double circles of vesicles that surround each branchial aperture.

Pigment also is mixed with spicules in the floor of the deep thoracic common cloacal cavity and in the layer of test surrounding the abdomina embedded in the basal test (comprising the lower half of the colony). Spicules are crowded in the basal layer of test, which is white, opaque and brittle. Spicules are globular (with flat-tipped rays) and burr-like, to 0.055 mm diameter.

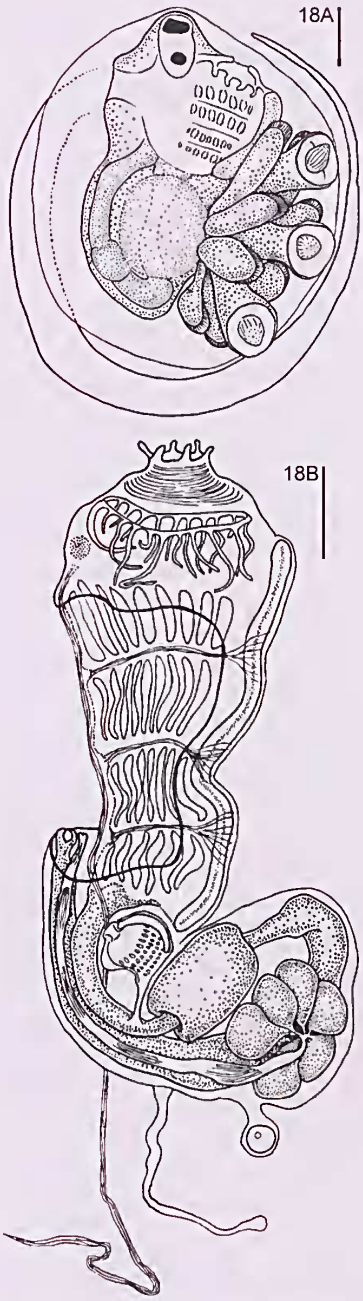

Fig. 18 A, *Lissoclinum conchylium* (NTM E221): larva. Scale bar: 0.1 mm; **B**, *Lissoclinum multifidum* (NTM E212): zooid. Scale bar: 0.2 mm.

Zooids have relatively large thoraces that cross the common cloacal cavity, each with a strap-like ventral test sheath also filled with spicules. The branchial sac is directly exposed to the common cloacal cavity. Zooids have dark brown cells in the haemocoel, especially conspicuous in the interstigmatal bars and transverse branchial vessels. The branchial sac has nine stigmata in an anterior row. Distinct longitudinal parietal muscles are present but neither retractor muscle nor atrial tongue were detected. The testis is divided into two with a straight vas deferens curving around between the follicles.

Larvae, present in the newly recorded specimen (collected in July), have a large and almost spherical (deeper than long) trunk 0.6 mm long, with the tail wound two-thirds of the way around it. The cerebral vesicle is protuberant, the pharynx has four rows of stigmata, and four ectodermal ampullae with modified cells along their tip are along each side of the three antero-median adhesive organs.

Remarks. The mauve colour, brittle test, brown cells in the haemocoel, large branchial sac, two testis follicles and absence of a retractor muscle are all characteristic of this species which, though not previously recorded from north of Heron Island, is now confirmed as a tropical species and can be expected to occur more widely in northern Australia.

Lissoclinum durabile Kott, 2001

(Fig. 27B)

Lissoclinum durabile Kott, 2001: 306.

Records. *New records*: Northern Territory (Darwin, reef off Charles Point, NTM E204). *Previously recorded* (see Kott, 2001): southern Australia (Esperance to Western Port); New South Wales.

This is the first record of this species from the tropics. It previously was thought to be a temperate species.

Description. In life and in preservative, the colonies of the species have a characteristic purple/yellow marble pattern – purple over the common cloacal canals and around the common cloacal apertures and yellow over the zooids (see Kott 2001: pl. 19B). The pigment is in minute spherical cells in the superficial test. Spicules are crowded throughout the test. Spicules are burr-like, to 0.04 mm diameter, with 15–17 rod-like to round-tipped club-shaped rays in optical transverse section. The ventral margins of up to four thoraces are stretched out along the hard, rigid and brittle pillars or straps of test that span the thoracic common cloacal cavity. The rectangular stigmata are exposed directly to the common cloacal cavity, only a narrow strip of pallial wall lying along each side of the endostyle. An atrial cavity is not present. Zooids lack both conspicious longitudinal muscles and a retractor muscle. On the

surface of the colony, each branchial aperture is surrounded by spicule-free test and is depressed into a small concavity surrounded by the hard circular rim of spicule-filled surface test. Zooids have brown cells in the haemocoel, and the testis is divided into two follicles.

Remarks. Colony form, colour and the zooids (including the spherical brown cells in the haemocoel) are identical with previously recorded material from temperate waters.

Lissoclinum limosum Kott, 2001

(Figs 20H, 27C)

Lissoclinum limosum Kott, 2001: 310.

Records. *New records*: Northern Territory (Darwin, Plater Rock, NTM E175, E182). *Previously recorded* (see Kott 2001): southern Great Barrier Reef.

Description. Colonies are delicate irregular sheets, translucent but with veins of brown pigment forming a network in the surface test around groups of four to eight zooids. The minute spicules form a capsule around the zooids. Common cloacal cavities are extensive, horizontal cavities. The testis is undivided.

Remarks. The newly recorded colonies generally conform with those previously described, although the common cloacal cavity is more extensive.

Lissoclinum multifidum Sluiter, 1909

(Figs 18B, 27D,E)

Lissoclinum multifidum Sluiter, 1909: 83 - Kott 2001: 311.

Records. *New records*: Northern Territory (Darwin, Mandorah Jetty, NTM E210, E212). *Previously recorded* (see Kott 2001): Northern Territory (Port Essington), Indonesia, Gulf of Thailand, Mauritius.

Description. The newly recorded colonies are fleshy and gelatinous. One (NTM E210) is a broad, irregular slab with randomly spaced common cloacal apertures. The other (NTM E212) is a narrow, cylindrical V-shape (Fig. 27E), about 1.5 cm wide with the zooids arranged along each side of almost parallel common cloacal canals across its width and large common cloacal apertures with areas of clear test around them where the canals converge (usually near the edge of the colony). Some cloacal canals are deep, extending beneath the zooids and forming large posterior abdominal spaces crossed by relatively few test connectives tying the upper part of the colony to the basal test. The primary common cloacal canals separate clumps of zooids from each other. Secondary canals penetrate amongst the zooids in each clump at thorax level (Fig. 18B). The long retractor muscles extend down into the basal test through the test connectives. Conspicuous opaque granular but non-calcareous vesicles (to 0.05 mm diameter) are in the test, especially in the surface between the rows of zooids but also they are present around the zooids. They are absent from the basal test where embryos are being incubated in the narrow colony (NTM E212).

The *in situ* photographs of the two newly recorded specimens (both taken from a reef, Mandorah Jetty, 7–9 m, 16 July 2001) show their appearance in life to be dramatically different (see Fig. 26D,E). One colony (NTM E210) is orange and similar to *Lissoclinum concavum* Kott, 2001 (pl.18H); and the narrow cylindrical V-shaped colony (NTM E212), has white bands across it, alternating with the transparent test. Small, sparsely distributed, burr-like spicules (to 0.015 mm) are in the orange specimen but not in the white one and in both the white colour is conferred by the characteristic spherical cells in the surface test and around the zooids.

Zooids are about 1.5 mm long, with 12 stigmata in the anterior row and a circle of up to 10 testis follicles. The ovum projects from the zooid, separated from it by a short, narrow constriction. Larvae, present in the larger colony (collected in July) have a trunk 1.0 mm long – longer than previously recorded – with the tail wound halfway around it. The usual three lateral ectodermal ampullae are on each side, an abdominal blastozooid is on the right side of the oozooid, a thoracic bud is on the left, three deep antero-median adhesive organs have long, narrow stalks and pyriform axial cones, and the cerebral vesicle protrudes anteriorly. One larva with only two antero-median adhesive organs was observed but this appears to be abnormal.

Remarks. Despite their dramatically different appearance in life, preserved specimens cannot be distinguished from each other nor from other (previously recorded) specimens. The presence of a few small burr-like spicules in the specimen that most closely resembles *Lissoclinum concavum*, suggests a close relationship with that species and the difference in the size and distribution of spicules present may be the only distinguishing character available. At this stage, the larva of *L. concavum* is not known.

Lissoclinum multitestis (Monniot and Monniot, 1996) originally assigned to *Diplosoma* because it has an aspicular colony, has 5–7 testis follicles and a straight vas deferens like the present species. The larva also appears to be characteristic of *Lissoclinum*, with the oozooid in the centre of the trunk, and it has three antero-median adhesive organs and six pairs of ectodermal ampullae. The species, like *L. concavum*, appears to be closely related to the present one, and the dramatic differences implied in the original description of *L. multitestis* may be the result of misinterpretations. The implications that gonads are in a pouch of the body wall, and that a position in the gut loop is their more usual location (see Monniot and Monniot 1996: 169) are both incorrect. They are in the

usual position against the nominally dorsal side of the gut loop, *i.e.* behind the ventrally flexed part of the loop in this species (see Kott 2001); and their position in *L. multitestis* does not constitute a distinction from other species of the Didemnidae. The confined atrial aperture (Monniot and Monniot 1996: fig 18A) is not found in other species of this genus, and appears to be too small to accommodate the ciliary current that would be generated by a branchial sac of the size indicated. There also are aspects of the figured larva (Monniot and Monniot 1996: 169, fig. 18E) that appear to be incorrect, viz. the turned back ectodermal ampullae, if turned forwards, would over-reach the incongruously short-stalked adhesive organs and obstruct their contact with the substrate; and although it is stated that there are no blastozooids, there is no evidence that they do not develop following further differentiation of the oozooid. Nevertheless, there are size-related characters that distinguish *L. multitestis* from the present species. The branchial sac has twice the number of stigmata per row, and the zooid and larval trunk are each twice the size of the present species. The living colony looks different from the present species. The retractor muscle has not been reported in *L. multitestis* but may be present; nor have the spherical cells in the test been reported.

Diplosoma translucidum (Hartmeyer, 1909)

(Figs 27F, G,?H)

Leptoclinum translucidum Hartmeyer, 1909: 1490 (nom. nov. for *Leptoclinum perspicuum* Sluiter, 1909: 79).

Diplosoma translucidum - Kott 2001: 343 and synonymy.

Records. *New record*: Northern Territory (Darwin, Navy Base Rock Wall, NTM E160, ?E163). *Previously recorded* (see Kott 2001): NW Australia, Queensland, Indonesia, New Caledonia.

Description. The newly recorded, translucent, whitish colony is growing around tangled fishing line. The relatively small zooids are in clumps anchored to the basal test by short connectives. Thoraces are held close to the surface test by short branchial siphons. Larvae, present in the colony collected in September (NTM E160), have an oozooid and a blastozooid in the anterior part of the 0.6 mm long trunk and two pairs of ectodermal ampullae. Whitish spherical cells were observed, packed in the test around zooids and larvae. However these were not detected in the scanning electron micrographs.

The colony (NTM E163) questionably assigned to this species has a characteristic colony, white in life with small zooids attached to the surface test by short branchial siphons and to the basal test by relatively short connectives which have two or three branches or are unbranched (each zooid being in a separate strand of test between the basal and surface test). In preservative, however, this colony is dark plum-coloured throughout, the test containing orange to brown spherical cells crowded around and obscuring the zooids. These pigment cells (which resemble the pigment cells in *Lissoclinum badium*) are beneath the layer of white cells in the surface test. Their significance is not understood. The colony is white in life.

Remarks. The plum-coloured colony superficially resembles colonies of *Diplosoma ferrugeum* (Kott, 2001) and has the characteristic clumps of small zooids in tough translucent test. However it has smaller zooids, shorter, less branched basal test connectives and larvae have a shorter trunk than recorded for *D. ferrugeum*. Further, although the white cells crowded in the test around the zooids and larvae superficially resemble the morulae in *D. ferrugeum*, they do not appear to be homologous.

Diplosoma virens (Hartmeyer, 1909)

Leptoclinum virens Hartmeyer, 1909: 145.

Diplosoma virens - Kott 2001: 347 and synonymy.

Diplosoma pavonia - Monniot and Monniot 2001: 278.

Records. *New record*: Northern Territory (Port Essington, NTM E29). *Previously recorded* (see Kott 2001): NE, NW Australia and Northern Territory (Darwin, Cape Don); western Pacific and Indian Ocean.

Remarks. The newly recorded colonies are tough cushions to 3 cm long, forming a mosaic around coral rubble.

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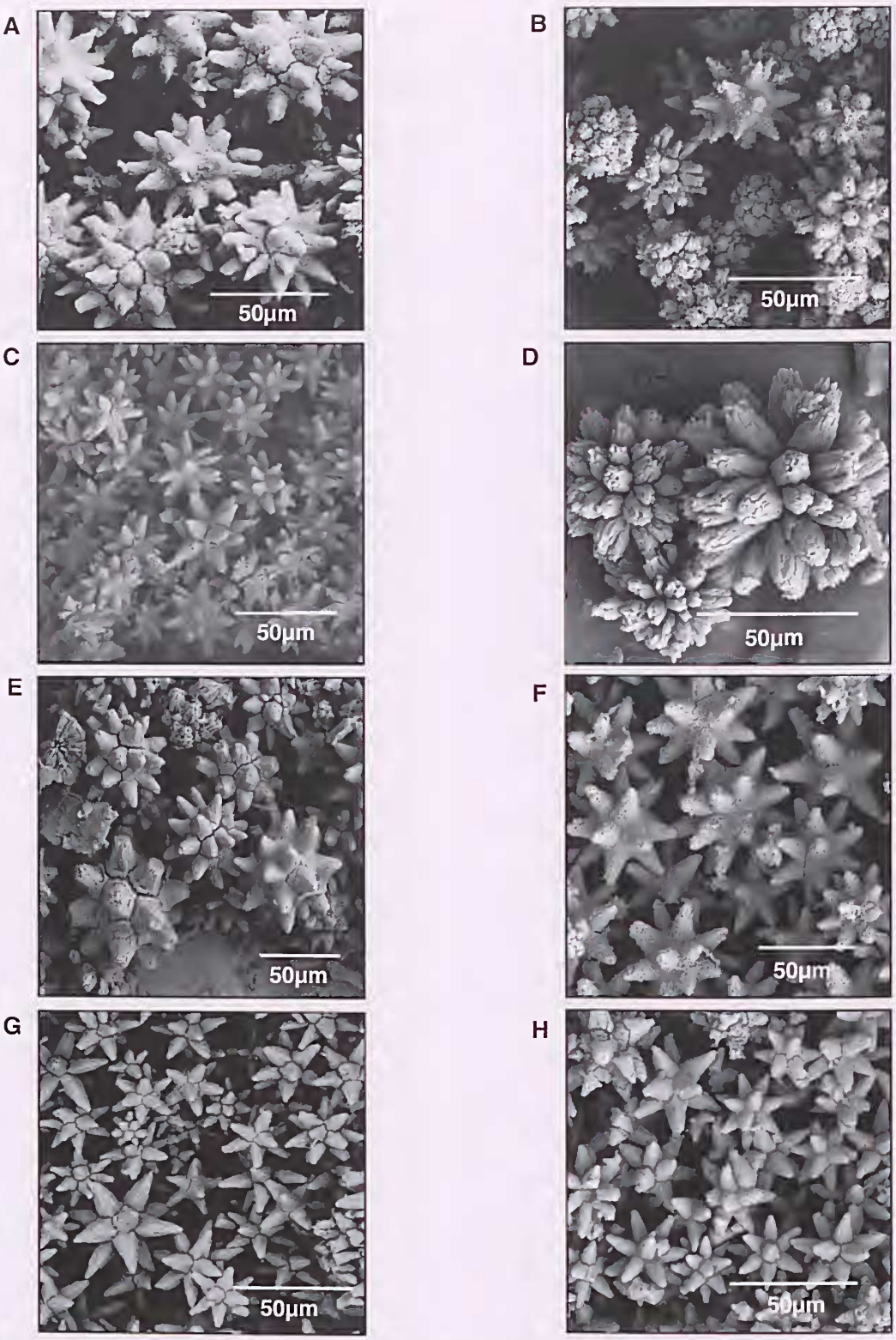

Fig. 19. Scanning electron micrographs of calcareous spicules from the test of **A**, *Leptoclinides aciculus* (NTM E185); **B**, *Leptoclinides complexus* (NTM E13 holotype); **C**, *Polysyncraton cuculliferum* (ZMA TU490 holotype); **D**, *Polysyncraton dromide* NTM (E211); **E**, *Polysyncraton pavimentum* (NTM E170); **F**, *Polysyncraton pseudorugosum* (NTM E21); **G**, *Didemnum clavum* (NTM E158); **H**, *Didemnum madeleinae* (NTM E230).

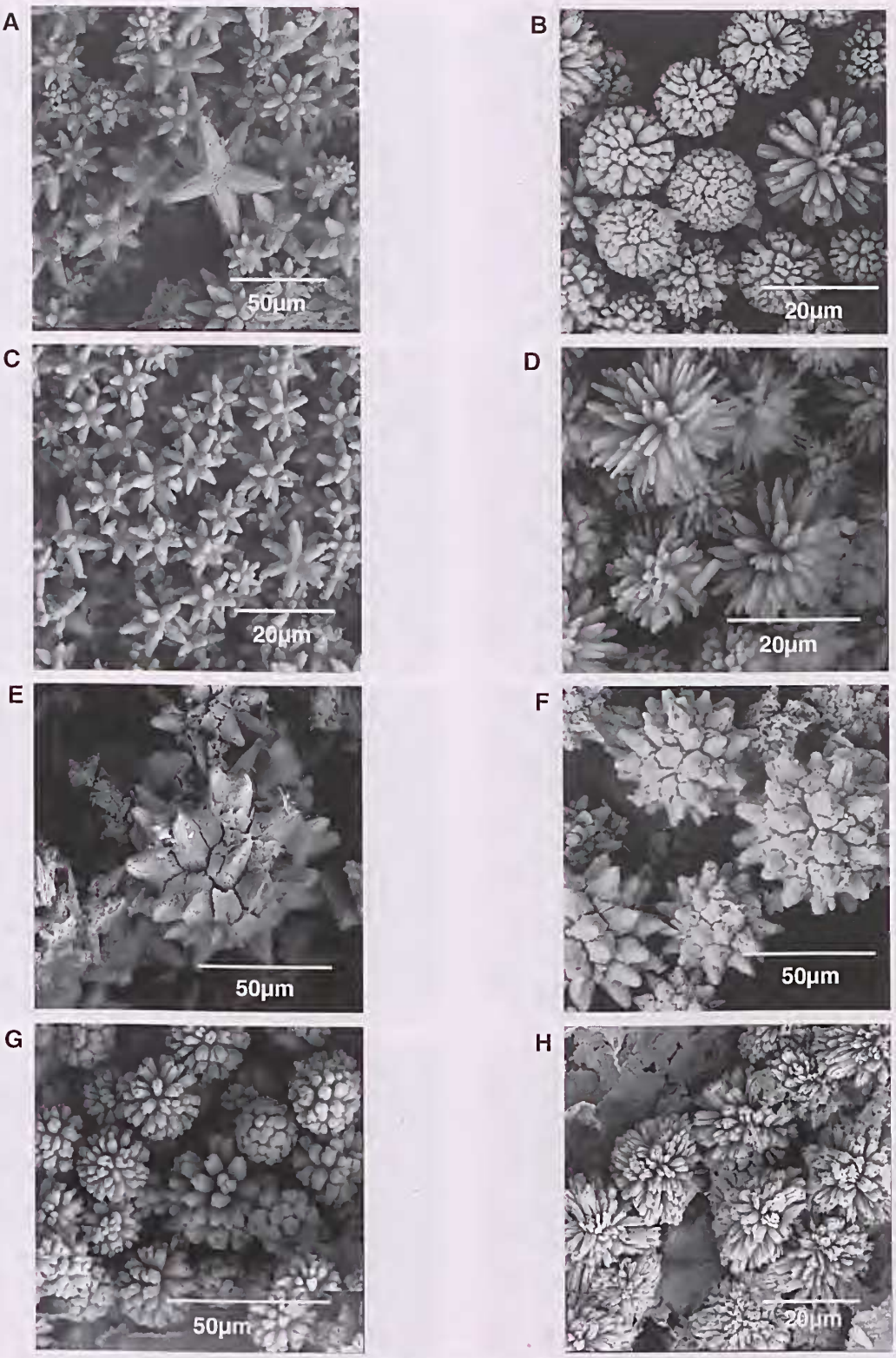

Fig. 20. Scanning electron micrographs of calcareous spicules from the test of **A**, *Didemnum membranaceum* (*D. turritum* Michaelsen, 1930, ZMH T1701 syntype); **B**, *Didemnum parau* (NTM E153); **C**, *Didemnum perplexum* (NTM E206); **D**, *Didemnum psammatode* (QM G303655); **E**, *Trididemnum marmoratum* (QM G308587); **F**, *Trididemnum planum* (NTM E192); **G**, *Lissoclinum conchylium* (NTM E221); **H**, *Lissoclinum limosum* (NTM E182).

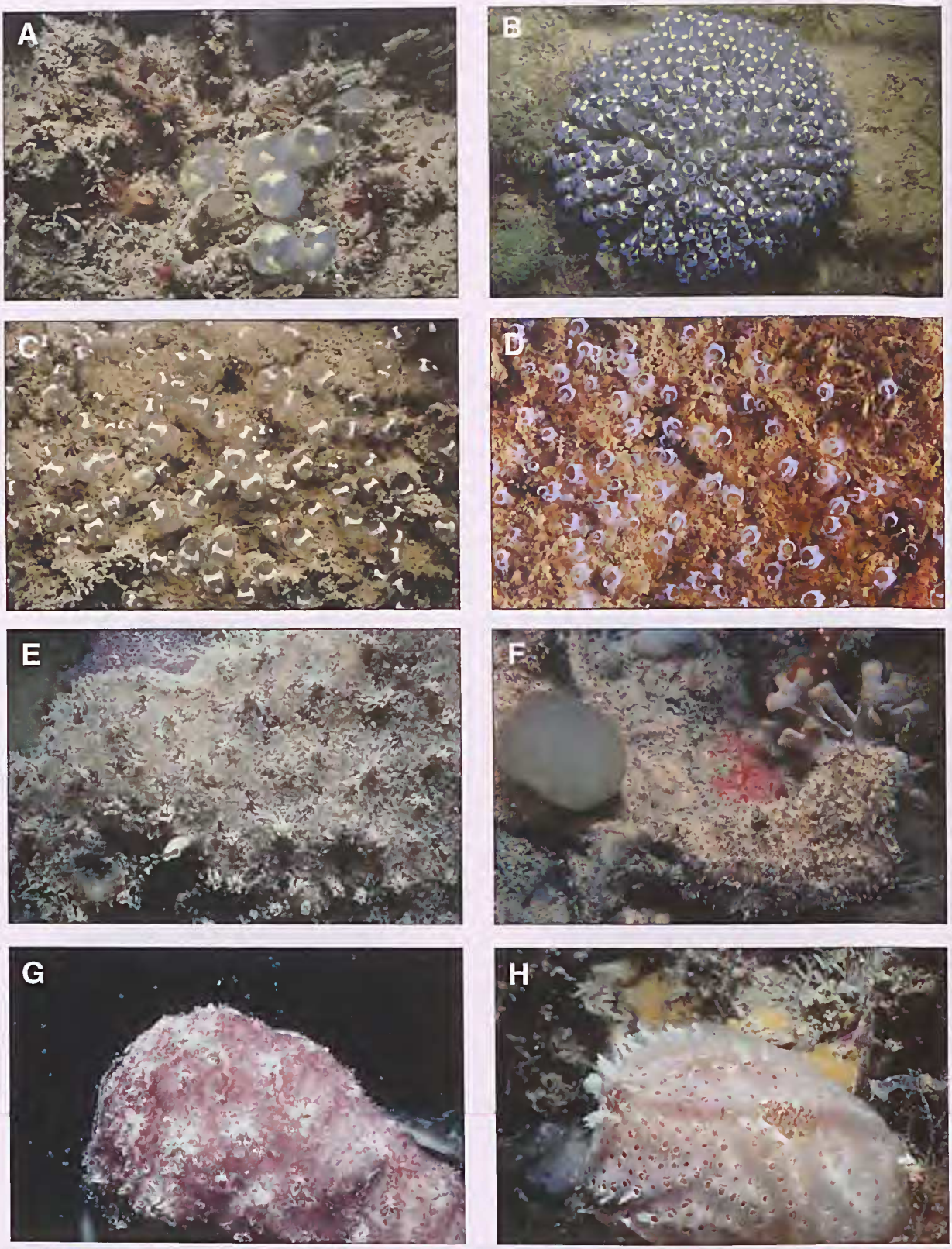

Fig. 21. **A**, **B**, *Clavelina amplexa* – **A** (NTM E155 holotype); **B** whole colony from East Point, Darwin; **C**, *Clavelina oliva* (NTM E176); **D**, *Pycnoclavella diminuta* (NTM E220); **E**,**F**, *Distaplia cuspidis* (NTM E198 paratype, E200); **G**, **H**, *Distaplia mikropnoa* (NTM E199, E200).

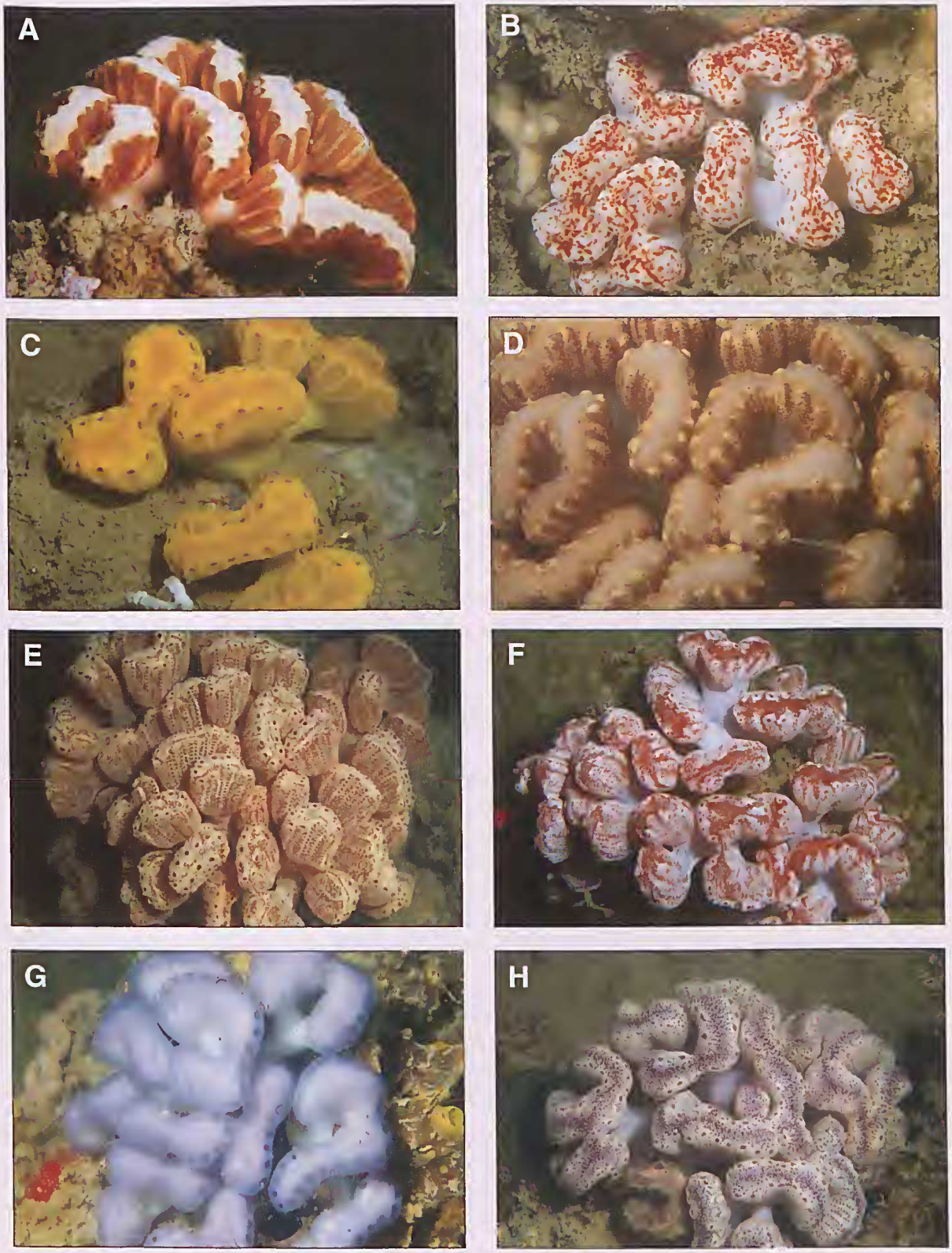

Fig. 22A–H. *Sycozoa seiziwadai* showing colour variations.

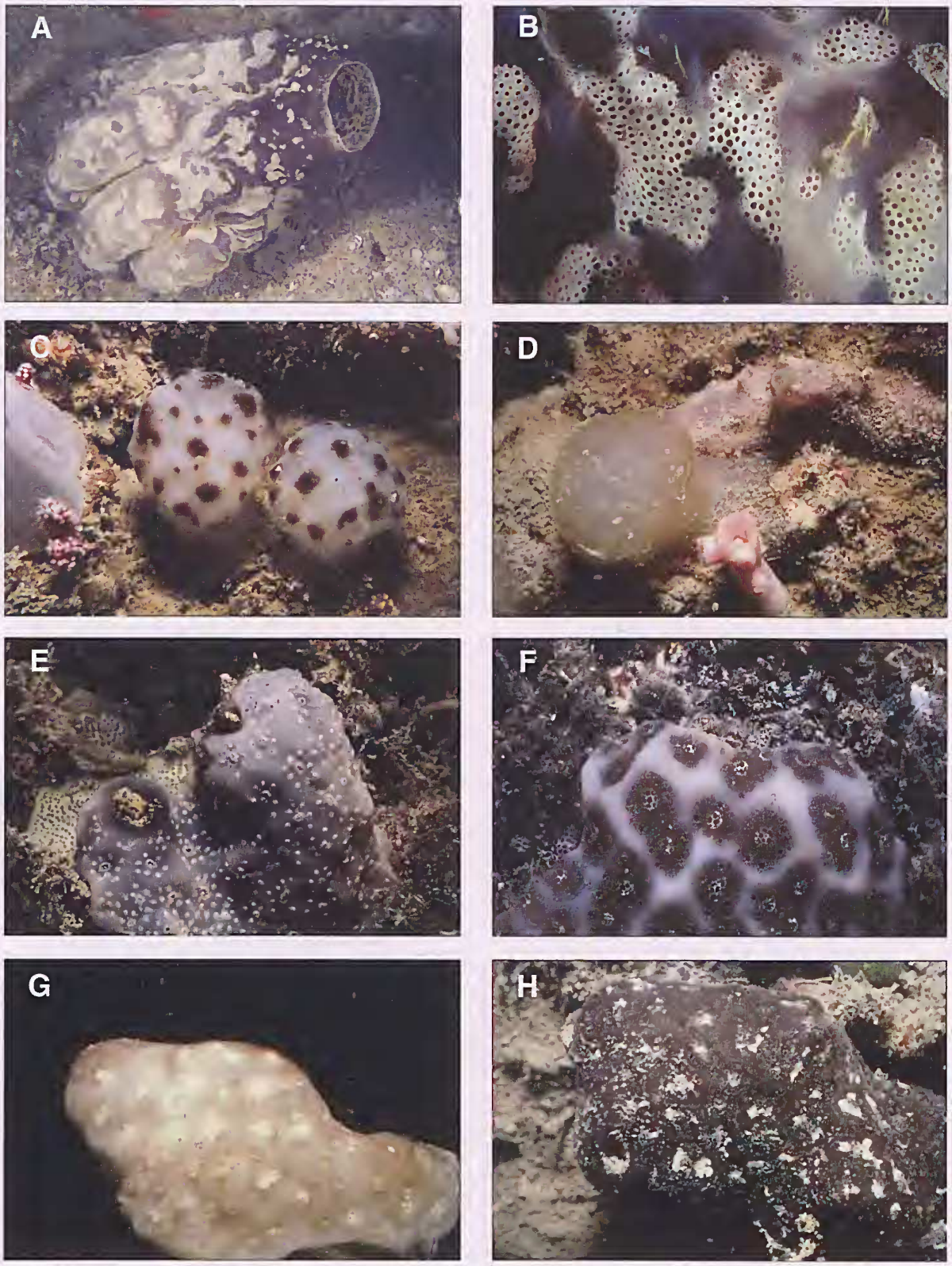

Fig. 23. **A**, **B**, *Hypodistoma deerratum* (NTM E216); **C**, **D**, *Polycitor circes* (NTM E179, E180); **E**, **F**, *Eudistoma eboreum* (NTM E213); **G**, *Eudistoma superlatum* (NTM E156); **H**, *Cystodytes philippinensis* (NTM E157).

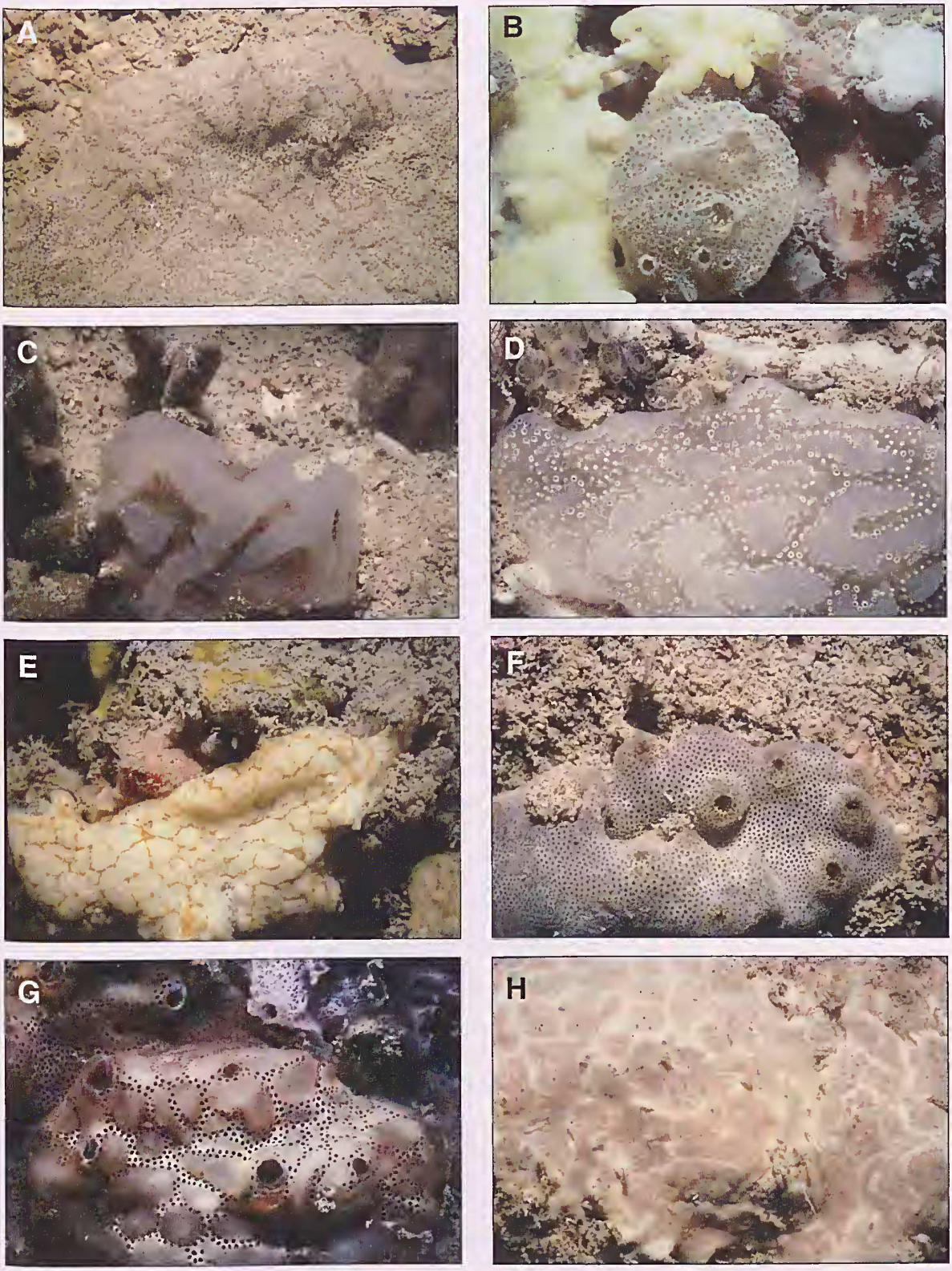

Fig. 24. **A**, **B**, *Synoicum macroglossum* (NTM E168, E202); **C**, *Aplidium grisiatum* (NTM E151); **D**, *Aplidium multiplicatum* (NTM E169); **E**, *Leptoclinides aciculus* (NTM E159); **F**, *Polysyncraton cuculliferum* (NTM E174); **G**, *Polysyncraton dromide* (NTM E154); **H**, *Polysyncraton pavimentum* (NTM E170).

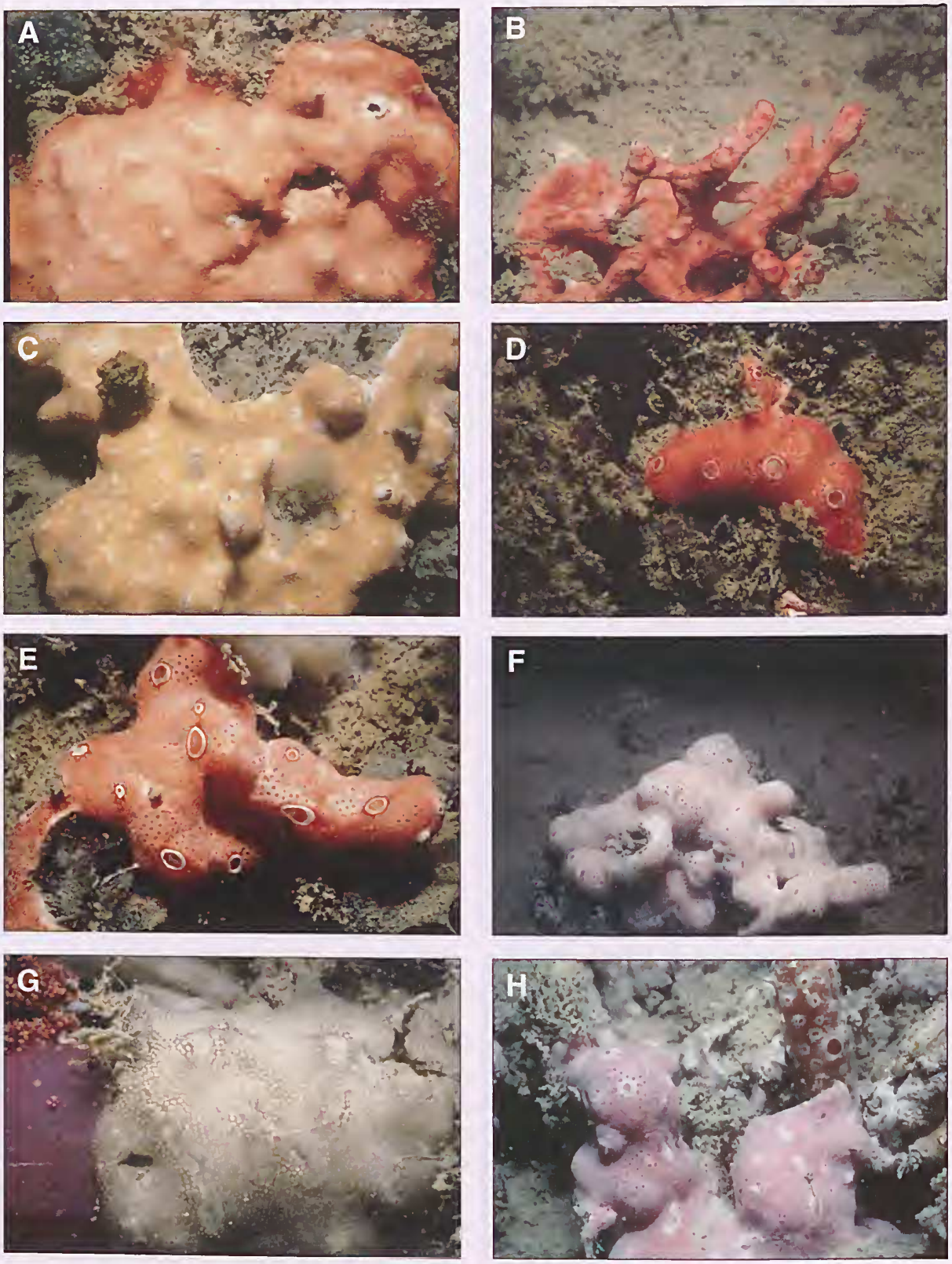

Fig. 25. **A**, **B**, *Didemnum clavum* (NTM E150, E183); **C**, *Didemnum granulatum* (NTM E152); **D-F**, *Didemnum madeleinae* (NTM E178, E184, E203); **G**, *Didemnum paran* (NTM E153); **H**, *Didemnum perplexum* (NTM E206).

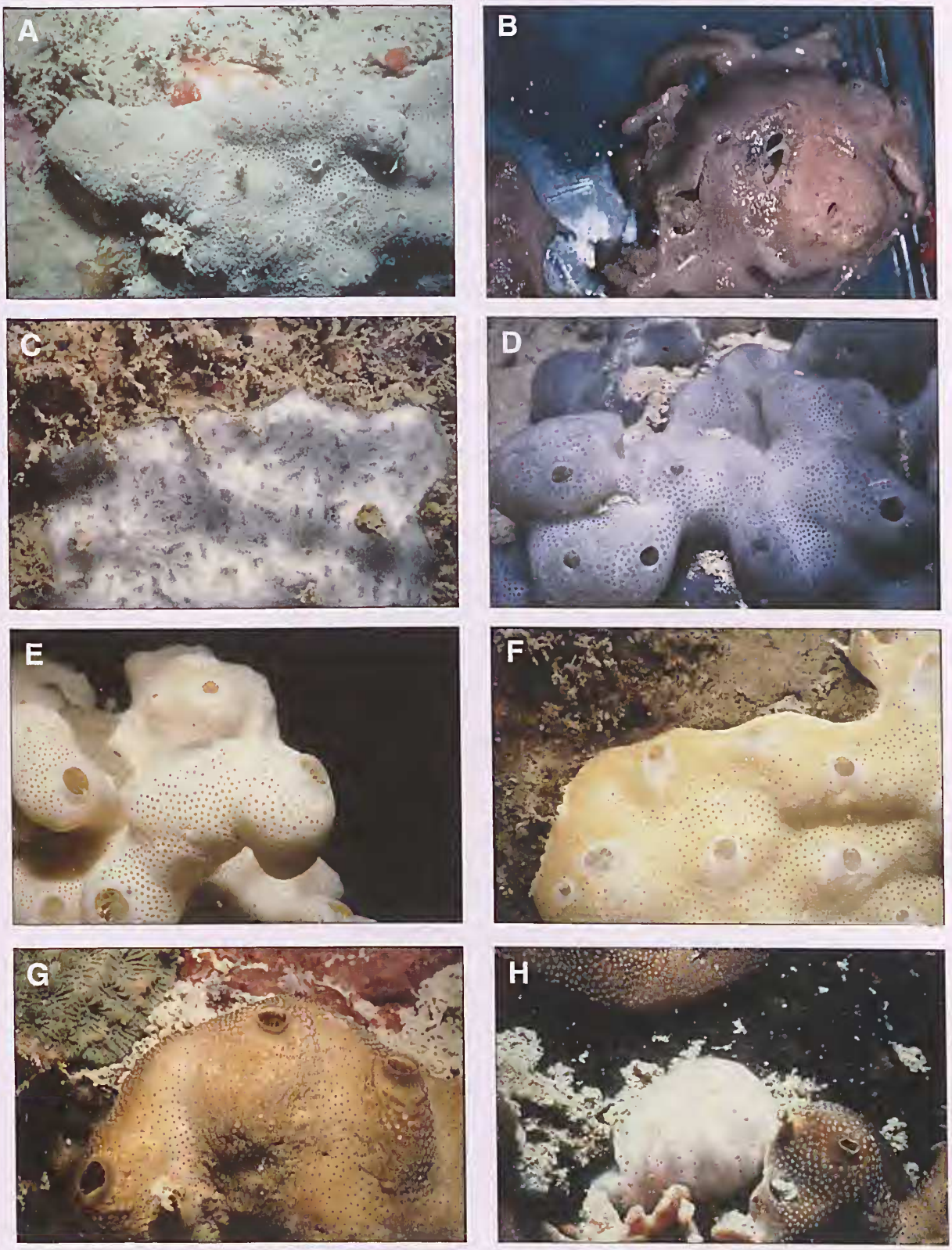

Fig. 26. **A**, *Didemnum psammatode* (NTM 207); **B**, *Trididemnum marmoratum* (deck photo, QM G308587); **C**, *Trididemnum planum* (NTM E191); **D**, *Trididemnum savignii* (NTM E214); **E-H**, *Lissoclinum badium* (NTM E173, E190, E186, E189 brown colonies).

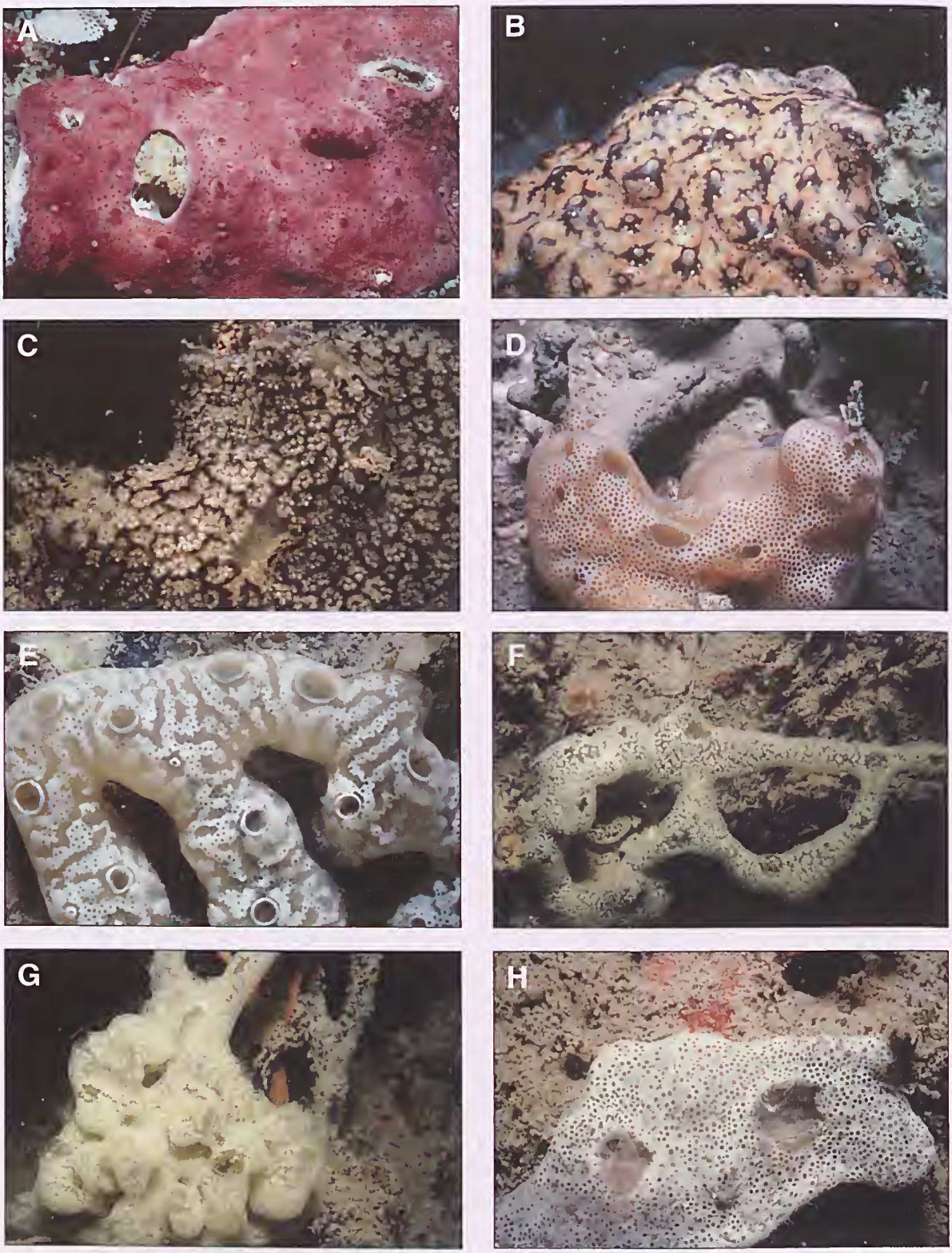

Fig. 27. **A**, *Lissoclinum conchylium* (NTM E221); **B**, *Lissoclinum durabile* (NTM E204); **C**, *Lissoclinum limosum* (NTM E182); **D**, **E**, *Lissoclinum multifidum* (NTM E210, E212); **F**, **G**, *Diplosoma translucidum* (NTM E160); **H**, *?Diplosoma translucidum* (NTM E163).

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